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A case study of the USS Dwight D. Eisenhower collision and its implications

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THESIS

A CASE STUDY OF THE USS *DWIGHT D. EISENHOWER* COLLISION AND ITS IMPLICATIONS

by

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September 1993

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Collisions at sea have and continue to be one of the most misunderstood phenomena of our modern transportation era. This thesis is a case analysis of the USS *DWIGHT D. EISENHOWER* (CVN 69) collision. Building on data from the National Transportation Safety Board's and the U.S. Navy Judge Advocate General Corps' investigations, it attempts to resolve inconsistencies between these governmental sources and interviews from four of the six principal officers involved in the mishap. The findings reveal that numerous causal factors were not sufficiently explored by the investigative bodies. Of greatest significance was the neglect of the *EISENHOWER* bridge organization, which was in disarray in the moments prior to the collision. This disorganization was the result of a six-month deployment in which specific Officers of the Deck focused their watch routines on the whims of the ship's Navigator. This dependence resulted in a poor decision process, and ultimately the inability to act appropriately in situations requiring prompt action.

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A Case Study of the USS *DWIGHT D. EISENHOWER* Collision and its Implications

by

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Submitted in partial fulfillment
of the requirements for the degree of

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ABSTRACT

Collisions at sea have and continue to be one of the most misunderstood phenomena of our modern transportation era. This thesis is a case analysis of the USS *DWIGHT D. EISENHOWER* (CVN 69) collision. Building on data from the National Transportation Safety Board's and the United States Navy Judge Advocate General Corps' investigations, it attempts to resolve inconsistencies between these governmental sources and interviews from four of the six principal officers involved in the mishap. The findings reveal that numerous causal factors were not sufficiently explored by the investigative bodies. Of greatest significance, was the neglect of the *EISENHOWER* bridge organization, which was in disarray in the moments prior to the collision. This disorganization was the result of a six-month deployment in which specific Officers of the Deck focused their watch routines on the whims of the ship's Navigator. This dependence resulted in a poor decision process, and ultimately the inability to act appropriately in situations requiring prompt action.

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I. INTRODUCTION

A. THE RESEARCH QUESTIONS

On 29 August 1988, the USS *DWIGHT D. EISENHOWER* (CVN 69) collided with the Spanish collier, URDULIZ, in the Entrance Reach Channel of Chesapeake Bay. The collision occurred approximately 4,000 yards from the *EISENHOWER*'s home pier. What is so interesting about the *EISENHOWER* collision is that the ship which she rammed was anchored. How is it that such a controlled and established procedure (entering port), could systematically breakdown in the moments prior to the collision?

In the aftermath of the incident, two separate investigations were undertaken to ascertain the causes of this collision. The United States' Navy Judge Advocate General Corps (JAG) and the National Transportation Safety Board (NTSB) were tasked with these inquiries. What were the findings of these reports and to what extent did they complement each other? Were there any other factors that should have been considered in the inquiries that were not brought out? And finally, did the collision change entering port procedures for the two main aircraft carrier commands? In other words did the collision make a difference?

The findings of the investigations identified numerous factors leading to the collision. The main reason cited in both investigations was the lack of swift, prudent action taken by the *EISENHOWER* bridge watch team, specifically the CO, Navigator, and the OOD, to avoid the URDULIZ. This thesis, reconstructing events of the morning of the collision, will attempt to show that the inaction of the bridge team was not the only determinant of the collision. Primarily, the core of this thesis is to offer another interpretation of why the collision occurred and to explain what other causal factors were critical to the overall understanding of the *EISENHOWER* collision.

B. STRUCTURE OF THESIS

To properly address these questions and to provide significant background information, a historical case on the *EISENHOWER* accident is presented in Chapter II. Chapter III is a summary of the NTSB and Navy JAG investigations on the reasons for the collision. This author provides his own interpretation of the findings and factors concerning the collision in Chapter IV, and generates a different perspective of the bridge environment onboard the *EISENHOWER*. The results of the author's findings indicate that there were additional factors that were either not explored in the investigations, or were glossed over. Also contained in Chapter IV is an overview of Perrow's typology matrix found in

his book Normal Accidents with an application to the *EISENHOWER* collision. Finally, Chapter V consists of the summary and conclusion.

C. METHODOLOGY

This thesis employed a case study approach in its design, and relied on qualitative methods such as interviews and archival research to collect the data. Information gathered from informal, personal interviews of four of the six key officers on the bridge (Officer of the Deck, Junior Officer of the Deck, Junior Officer of the Watch, and the Helm Safety Officer) at the time of the accident supplemented the reports of the formal investigations.

D. SCOPE/BENEFITS

This thesis examines the U.S. Navy's largest capital ship, the aircraft carrier. The awesome power and presence of the aircraft carrier has long been a trademark of American diplomacy abroad. The passage: "Speak softly and carry a big stick" came to define the carrier's role during the late 1980s as the Cold War spiralled to an end. The strength of the carrier rests in its ability to swiftly travel to any foreign shore in the event of a crisis. Thus, the importance of the aircraft carrier cannot be ignored, as evident in the latest "bottom-up" review performed by the Clinton Administration. A 12 carrier force has become the centerpiece of naval warfare

strategy. What does this say about the importance of the carrier? It clearly and unequivocally states that the U.S. cannot maintain the profile of a superpower without the potency of this imposing ship.

This thesis was not an attempt to judge the imperfections of such a large ship, nor was it intended to discredit or pass judgment on those officers involved in the collision. Rather, it sought to illustrate the risk of operating a large ship in a narrow, inadequately defined channel, and to more fully elaborate on the explanations for the causes of the *EISENHOWER* collision. The *EISENHOWER* incident demonstrates that the unexpected can happen. It is hoped that this thesis can serve as a source of knowledge on how to prepare for the unexpected.

II. THE *EISENHOWER* COLLISION

A. OVERVIEW

On 29 August 1988, at approximately 0821, the USS *DWIGHT D. EISENHOWER* (CVN 69) collided with the Spanish bulk carrier, URDULIZ. The *EISENHOWER* was returning from her first extended deployment in almost three years, and was transiting the recently narrowed Entrance Reach Channel. The *EISENHOWER* sustained over two million dollars damage to her number 2 aircraft elevator and along the starboard side where the impact took place. The URDULIZ damage totalled over 350 thousand dollars and was confined to the bow. There were no injuries to personnel on either ship, nor did the collision render either ship unseaworthy.[Ref. 2:p. v] **Figure II-1** displays a chart of the accident site.

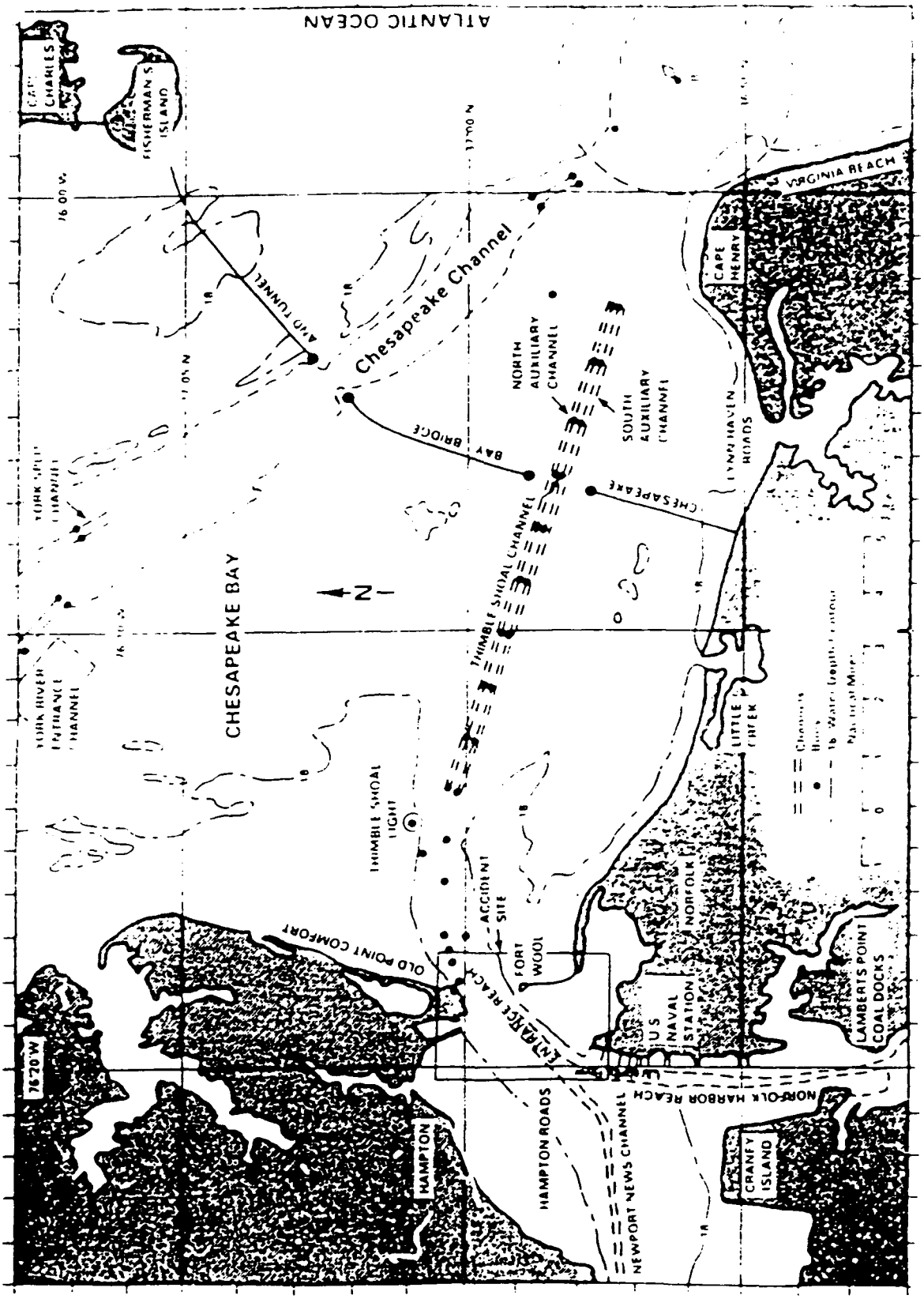

Figure II-1. Chart of the accident site

B. HISTORY

The *EISENHOWER* completed an 18 month Complex Overhaul (COH)[1] at Newport News Shipyard and Drydock in April of 1987. After returning to her home pier at the Norfolk Naval Operating Base (NOB) she began an intense period of underway workups. Most of the junior officers and enlisted personnel had little or no underway experience. This ten month period of workups would advance this experience dramatically to a highly seasoned crew ready and able to deploy for an extended deployment. The *EISENHOWER* and her crew were ready for their Mediterranean Sea deployment and to sail again.

The ship, in anticipation of the upcoming Mediterranean Sea deployment, began a Pre-Overseas Movement (POM)[2] period in January of 1988. During this period, crewmembers were expected to take leave and enjoy as much time with their families as possible. The next six months on the *EISENHOWER* would be spent patrolling the waters of the Mediterranean Sea on a scheduled deployment.

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[1]Complex Overhaul is a scheduled shipyard maintenance period for aircraft carriers. All new upgrades are made to the ship during this eighteen month period, including refueling of the nuclear reactor and replacement of catapult systems.

[2]The POM period consists of the ship beginning a gradual buildup of supplies and spare parts for a 6 month deployment. The process is particularly painful to the Supply Department which must ensure everything the ship needs for the deployment is onboard prior to leaving homeport.

C. THE DEPLOYMENT

The routine deployment commenced on 29 February 1988 and was characterized by extensive underway training. During this training, the crew conducted numerous SELEXs[3]; the scores received on these graded exercises revealed to some extent the ship's flawless performance. (Such exercises as man overboard, precision anchoring, and Sea Sparrow missile shoots were conducted during the SELEXs.)

The ship also made numerous ports of call over the 6 months and experienced no loss of aircraft or personnel prior to the last port call (an airman committed suicide immediately after the ship got underway from Cannes, France for the transit back to Norfolk). The outstanding performance on the SELEXs and the lack of any discrediting incident over the six month deployment did not go unnoticed. Indications were that the *EISENHOWER* would be awarded the Battle "E".

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[3]SELEX is an acronym for selected exercises; each ship in a particular class must accomplish, with certain proficiency, a number of selected exercises. These exercises are then graded by impartial graders (usually warfare qualified officers or senior enlisted) for submission in the competition for the Battle "E".

D. THE FINAL LEG OF THE TRANSIT

On the morning of 27 August, the *EISENHOWER* anchored in Bermuda to board approximately 500 male relatives and friends for the ship's "Tiger Cruise"[4] back to Norfolk. This last leg of the transit was anticlimactic; the crew had spent much of the transit on daily watches with relatives or friends, showing them the job or jobs they were responsible for on a daily basis. The atmosphere on the ship was light and spirited; although, with the arrival of the "tigers" the propensity to keep later hours and reminisce was strong.

The bridge watch team that would pilot the ship into Norfolk was determined; the Conning Officer/Junior Officer of the Deck (JOOD) along with the Officer of the Deck (OOD) conducted an entering port brief on the afternoon of 28 August for the Commanding Officer (CO), Executive Officer (XO), Navigator, Operations Officer, First Lieutenant, and all radar navigation and bridge watch personnel. The following items were briefed [Ref. 2:p. 6]:

- Relocation of buoys from the entrance to Thimble Shoals to Pier 12, in particular, the western relocation of Elizabeth River Buoy 1 to a point 350-400 yards inside the previously marked channel.
- A new navigation track in the vicinity of Thimble Shoals.
- Slowing to 5 knots prior to crossing the Hampton Roads Bridge Tunnel for docking pilot pickup.

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[4]A term used by the Navy to describe an event where male civilian guests of the Navy and family and friends of crewmembers board the ship to ride back into port. It allows the guests to experience firsthand the rigors of life at sea.

- Weather, currents, and tides expected at the time of entry.
- Expected helicopter operations.
- Order of return for the battle group ships.
- Setting of the low visibility detail.
- Assignment of the ready anchor.

The *EISENHOWER* Navigation Department (Navigator, Assistant Navigator, and the Chief Quartermaster) had been briefed by the Navigator of the relieving carrier, USS *JOHN F. KENNEDY* (CV 67), in the Mediterranean Sea about the relocation of buoys in Thimble Shoals Channel and the narrowing of the channel. The CO, Navigator, and the Assistant Navigator (the OOD for entering Norfolk) expressed concern at the brief about this new buoy alignment, but all were confident in their ability to safely navigate the 1,092 foot, 95,000 ton *EISENHOWER* through the channel.

The *EISENHOWER's* track through Entrance Reach Channel was intentionally laid by the Navigator along the northwest edge of the charted reach to compensate for the new position of Elizabeth River Buoy 1. The *EISENHOWER's* new track passed within 200 yards of anchorage ZULU (where the URDULIZ was anchored) and was tangent to X-RAY and YANKEE anchorages 250 yards from the center of the channel (all anchorages are shown in **Figure II-2**).

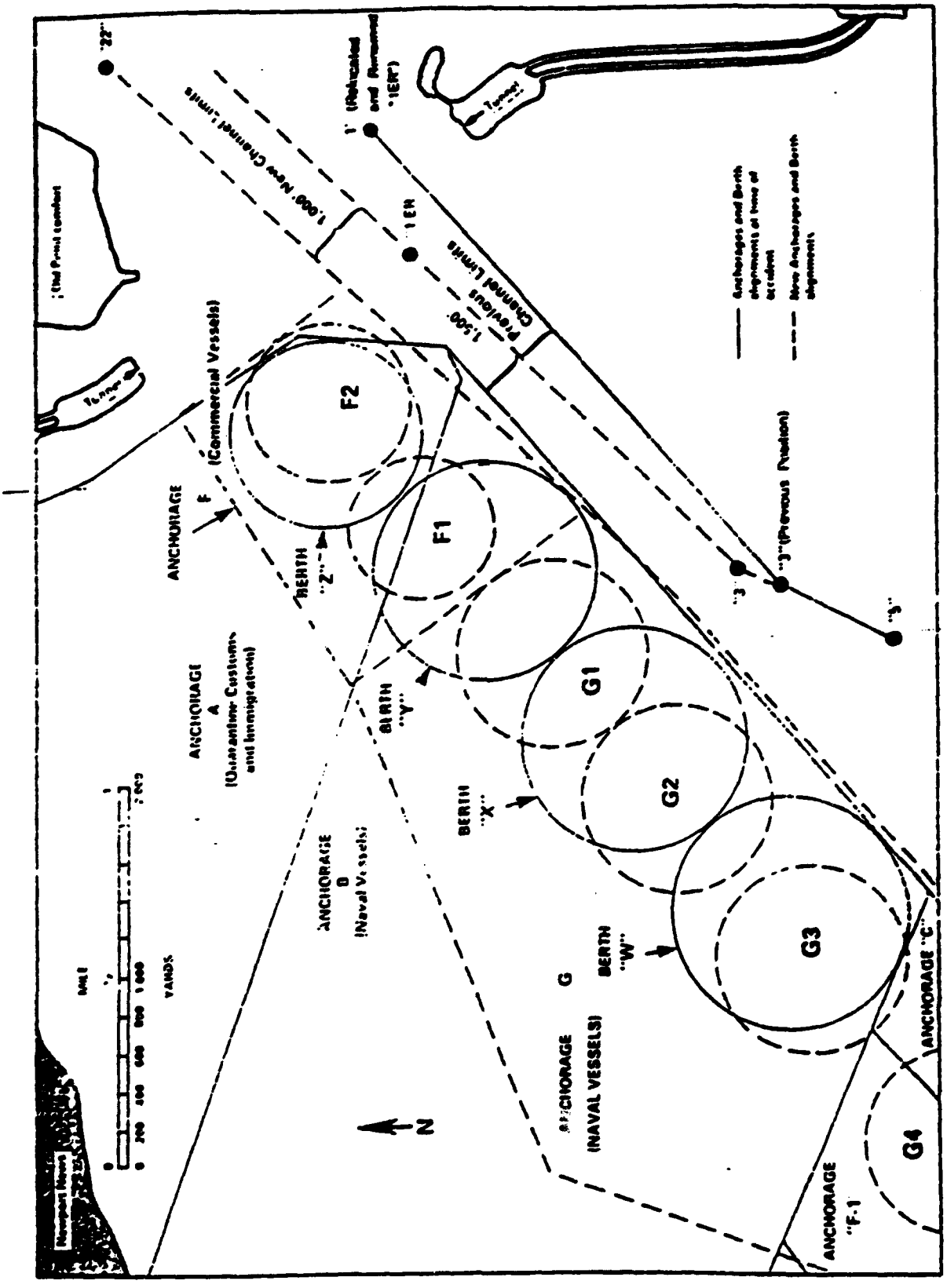

Figure II-2. Anchorages adjacent to Entrance Reach Channel

The new buoy positions were correctly plotted on the bridge and Combat Information Center (CIC) charts in accordance with the appropriate Notice to Mariners.[Ref. 2:p. 6]

1. Key Bridge Personnel and Their Backgrounds

a. Commanding Officer

The CO was a 51 year old aviator with the rank of Captain; he assumed command of the *EISENHOWER* in October of 1986. At the time of the collision, he had served as a commissioned officer for about 28 years with over 14 years of sea duty. Prior to his command tour on the *EISENHOWER*, he served 2 years as the CO of the USS *NIAGARA FALLS* (AFS 3) and approximately 3 years as the XO on the USS *CARL VINSON* (CVN 70), a sister ship of the *EISENHOWER*. As a CO and XO, he had completed numerous transits of the Hampton Roads channels. During the evening prior to the collision, the CO reported he had slept well in his cabin between 2130 and 0430. The only interruptions were calls from the OOD about vessel traffic.[Ref. 2:p. 12]

b. Navigator

The Navigator was a 42 year old aviator with the rank of Commander; he assumed the duties of Navigator in November 1986. At the time of the collision, he had been a commissioned officer for about 20 years. Prior to this assignment, he had accumulated 2 1/2 years of sea duty aboard the USS *MIDWAY* (CV 41). While onboard the *MIDWAY* he served as

the Assistant Navigator from September 1976 to January 1979 and also qualified as OOD. Upon being assigned to the *EISENHOWER*, he completed the Navigation Officer Shipboard Celestial Navigation Course and a 2 day practical shiphandling course. Prior to the collision, he had completed numerous transits of the Hampton Roads channels as Navigator of the *EISENHOWER*. He stated that he had "...plenty of sleep..." the night before entering Norfolk harbor. He had slept from 2100 to 0300 with two brief interruptions from the OOD. He awoke at 0300 and arrived on the bridge at 0330.[Ref. 2:p. 12-13]

c. Officer of the Deck

The OOD was a 32 year old aviator with the rank of Lieutenant; he assumed the duties as Assistant Navigator in June 1987 for his first shipboard assignment. At the time of the collision, he had served as a commissioned officer for about ten years. He had served as the Assistant Navigator during the ship's underway workups and had qualified as OOD in August 1987. He had never served as OOD during a transit into Hampton Roads. He said he slept five hours the night prior to entering Norfolk harbor; he awoke at 0300 and arrived on the bridge at 0345 to assume duties as Navigation Officer. At 0530, the Navigator assumed the duties of Navigation Officer and the Assistant Navigator assumed the duties as OOD for entering port.[Ref. 2:p. 13]

d. Conning Officer

The Conning Officer was a 22 year old Surface Warfare Officer (SWO) designate with the rank of Ensign; he assumed the duties of a division officer in December 1987 for his first shipboard assignment. At the time of the collision, he had served as a commissioned officer for a little over one year. He had been onboard less than ten months and was not JOOD qualified; this was his first entry into the Hampton Roads port area as a qualified bridge watchstander. According to ship's policy, the conning of the ship in restricted waters is a requirement which must be completed prior to being designated a JOOD.[Ref. 2:p. 6]

e. Junior Officer of the Watch

The JOOW was a 21 year old SWO designate with the rank of Ensign; he assumed the duties of a division officer in December 1987 for his first shipboard assignment. At the time of the collision he had served as a commissioned officer for a little over one year. He had been onboard for less than ten months and was JOOW qualified. This was his first entry into the Hampton Roads port area as a qualified bridge watchstander.[Ref. 2:p. 7]

2. The Bridge Watch and the Hours Before the Collision

At 0530 on the morning of 29 August the sea and anchor detail was set as had been planned. At the same time the OOD assumed the watch; this was, as mentioned earlier, his first

experience as OOD during sea and anchor detail. His normal station was as the Navigation Officer[5]. The Leading Chief Petty Officer (LCPO) for Navigation Department assumed the role of Navigation Officer for the Assistant Navigator during this transit. Normally the LCPO was the Navigation Plotter during sea and anchor detail. Although the LCPO had acted previously as Navigation Officer during sea and anchor evolutions on destroyer type vessels he had not performed this function onboard *EISENHOWER*.[Ref. 2:p. 7]

At 0602, the low visibility detail[6] was set in anticipation of poor visibility due to thunderstorms in the area. Due to the reduction in visibility, a lack of dependable visual fixes was not possible; at that time, the Navigator ordered the navigation lead (the team responsible for the tracking of the ship along its track) shifted to the navigation team in the Tactical Operations Plot (TOP). At 0648 the OOD, with the CO's permission, ordered the Engineering Officer of the Watch (EOOW) to place the ship's engineering plant into a "restricted maneuvering" lineup[7].

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[5]A position held by the Assistant Navigator during sea and anchor detail.

[6]A detail that posts additional officers and enlisted personnel at various strategic points around the ship to act as extra sets of eyes and ears for waterborne traffic.

[7]The steam plant lineup that allows for quicker acceleration and deceleration among the throttlemen in the engine control rooms. The maneuvering combination is used during special sea and anchor detail, when coming alongside another ship, alongside, and in a narrow channel.

The ship was 5 minutes from entering Thimble Shoals Channel when the Secretary of the Navy (SECNAV) and COMMANDER, NAVAL AIR FORCE ATLANTIC FLEET (COMNAVAIRLANT) arrived on the bridge to pay a visit to the CO and the embarked Flag Officer - COMMANDER, CRUISER DESTROYER GROUP TWELVE (COMCRUDESGRU TWELVE). COMNAVAIRLANT departed at 0732; the SECNAV remained onboard until 0807.

While transiting Thimble Shoals Channel, the Shipping Officer contacted the USS *THOMAS C. HART* (FF 1092), part of the *EISENHOWER* Battle Group, on radio and was advised that ships occupied anchorages X-RAY and ZULU. The Shipping Officer passed this information to the OOD and the OOD reported it to the Navigator. At 0726, at the Navigator's request, the navigation lead was transferred back to the bridge from TOP. At 0755, the bridge navigation team began experiencing difficulty obtaining a visual fix off the charted landside designations.

At approximately 0800, both the CO and OOD recognized that the true wind was out of the southeast (off the port beam), that reports from TOP were of negligible set and drift[8], and that they visually sighted the URDULIZ off the starboard bow in ZULU anchorage. At 0804 TOP obtained a radar fix showing the ship to be on track. [A summary of key events is shown in **Exhibit II-1**.]

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[8]A term to explain the distance a ship is "pushed" off its intended track by wind and current.

EXHIBIT II-1
KEY EVENTS WHICH OCCURRED PRIOR TO ENTRANCE REACH CHANNEL

TIME	EVENTS
0530	Sea and anchor detail set
0602	Low visibility detail set
0648	OOD orders "restricted maneuvering" set
0726	Navigator orders navigation lead switched back to the bridge
0755	The bridge navigation team begins experiencing difficulty obtaining a visual fix
0804	TOP obtains radar fix showing ship to be on rack

Source: National Transportation Safety Board Investigation

The CO, OOD, and Navigator conferred at 0805, and based on the ship's proximity to Old Point Comfort, **visually** estimated the ship to be on track.

When, at 0806, the OOD ordered the Conning Officer to begin a pre-planned turn to course 229° into Entrance Reach Channel, he discussed with the CO whether the stern of the ship would clear URDULIZ during the final turn to the navy piers. They both agreed that the ship would be well clear of the URDULIZ. [A summary of the preceding events is shown in **Exhibit II-2.**]

EXHIBIT II-2
KEY EVENTS WHICH OCCURRED AS THE *EISENHOWER* BEGAN HER TURN INTO ENTRANCE REACH CHANNEL

TIME	EVENTS
0806	The Navigation Plotter, a first class petty officer, reports his inability to obtain a fix to the Navigation Officer
	Navigation Officer instructs bearing takers to attempt fixes at one minute intervals
	Navigation Officer reports problem of obtaining visual fixes to Navigator
	Bridge Liaison reports that the ship is on track
	Navigator receives true wind calculation from JOOW - 152 degrees at 23 knots (off the port beam)
	CIC designates URDULIZ "Skunk Z" bearing 238 degrees at 2800 yards
	By the completion of the turn to 229°, the CO, Navigator, and OOD had been informed of the bridge navigation team to obtain a visual fix
	Once on course 229°, the OOD obtained from the JOOW a bearing drift on URDULIZ

Source: National Transportation Safety Board Investigation

The ship continued its transit along Entrance Reach Channel. The following key events occurred at 0807 as shown in **Exhibit II-3**.

EXHIBIT II-3
KEY EVENTS WHICH OCCURRED AFTER THE *EISENHOWER* ENTERED INTO ENTRANCE REACH CHANNEL

TIME	EVENTS
0807	The ship enters Entrance Reach Channel.
	SECNAV departs the ship via H-46 helicopter.
	Navigation Plotter again calls "no fix".
	Navigation Officer checks status of all bridge gyros; he finds them functioning properly.
	Navigation Officer orders all bearing takers to reconfirm their targets.
	Navigator checks the MK 19 Gyro Repeater against the Ship's Inertial Navigation System (SINS); he finds them to be within 1/2 degree of each other.
	Radar navigation team in TOP again reports the ship on track and passing red buoy 22 to starboard.

Source: National Transportation Safety Board Investigation

The bridge team was in the process of beginning its final turn to NOB. The OOD, the officer responsible for maintaining the "big picture", was in the best position to see what was clearly unfolding - a possible collision course with the URDULIZ. At 0807 the SECNAV departed the *EISENHOWER* via an H-46 helicopter. The engine noise of the H-46 degraded communications with bearing takers at their outside stations; thus, the capability to pass bearing marks to the bridge Navigation Plotter were extremely degraded, causing even more difficulty in obtaining an accurate fix.

At 0810, the radar navigation team in TOP held the ship at or slightly right of track. The Bridge Liaison reported TOP **holding the ship on track**. TOP **again** estimated negligible set and drift. Also, Shipping in CIC reported "Skunk Z" bearing 236 degrees, course 270°, speed 2 knots. Between 0807-0811 the ship travelled approximately 950 yards, or about 7.1 knots.[Ref. 1:p. 11]

E. THE FINAL TEN MINUTES

In the final minutes prior to the collision, the din on the bridge became increasingly loud due to the sighting of the homecoming crowd at the pier, the media on the bridge, and the distraction of the URDULIZ as the *EISENHOWER* transited the final 4000 yards to her pier. The excitement and anticipation of returning home diverted the bridge team's attention and focus from their primary responsibility: safe piloting of the ship. The ship entered into a state of "extremis".

At 0811 the Navigator recommended to the OOD to slow to "bare steerageway"[9] to arrive on time (0845) at Elizabeth River buoy 3, the pilot pick-up point. The ship was **four minutes** ahead of her estimated time of arrival; the OOD concurred with this recommendation and instructed the Conning Officer to slow to 3 knots. The CO **did not** hear the order to reduce speed to "bare steerageway". At 0812 "Skunk Z"

[9]A speed which is just enough to maintain wash over the rudders allowing steering capability (usually 3-5 knots).

(URDULIZ) had a bearing of 238 degrees at 1500 yards. At 0813 the Bridge Liaison reported that TOP held the ship 25 yards **right of track**. No set and drift was calculated. The 0813 TOP fix was determined using 4 radar arcs. The intersection of these arcs was a four-sided figure whose sides were 175 yards, 90 yards, 100 yards, and 125 yards in length. The northwestern corner of this figure placed the ship approximately 175 yards right of track. A measurement of the point in the four-sided figure chose by the Piloting Officer as the ship's position placed the ship 75 yards right of track, vice the 25 he had reported. At 0813 the USS *GLENARD P. LIPSCOMB* (SSN 678) contacted the *EISENHOWER* on bridge to bridge radio and requested a port to port passage in Entrance Reach Channel; this was granted by the OOD. At 0813 another H-46 helicopter lifted off from the flight deck, **again** degrading the reports from the bearing takers to the Navigation Plotter. At 0814, COMCRUDESGRU TWELVE arrived on the bridge to discuss SECNAV's visit. The URDULIZ was now clearly visible to all bridge personnel.

As the ship passed buoy 1 to port at 0815, the Navigation Officer relieved the Navigation Plotter and took over the ship's plotting duties. He was unable to obtain a fix on his initial attempt at time 0815. The Navigation Officer again ordered all bearing takers to confirm their targets. At approximately 0815, the URDULIZ faded from the radar at a point 1200 yards from the *EISENHOWER*. Members of the watch

team considered URDULIZ anchored in ZULU anchorage, with anchor chain visible, heading into the wind, northwest of the channel, and no way on. During the period that the bridge navigation team was unable to obtain a fix, **no recommendation** was made by the Navigator to shift the navigational lead back to TOP. Subsequent to the OOD receiving a single bearing drift report from the JOOW at 0806, not one watch officer determined a bearing drift on URDULIZ utilizing the centerline alidade. However, radar bearings obtained by Shipping in CIC at 0806, 0810, and 0812 all indicated that URDULIZ had Constant Bearing, Decreasing Range (CBDR). This information was displayed on the Surface Contact Status Board behind the CO's chair on the bridge.

Finally, at 0816 the Bridge Liaison reported that TOP held the ship 200 yards right of track. The Piloting Officer in TOP reported to the bridge at 0816 that the nearest hazard to navigation was shoal water. Informed by the Bridge Liaison of URDULIZ' position, the Piloting Officer immediately changed the nearest hazard to navigation to URDULIZ and recommended a left turn to course 225° to avoid URDULIZ. The Bridge Liaison, as ordered by the OOD, passed to the Piloting Officer that a course of 225° was not a sufficient correction to avoid URDULIZ; he then recommended to continue left to course 220°. TOP was not even aware of URDULIZ' position in ZULU anchorage until 0816. The 0811 - 0815 events are shown in **Exhibit II-4**.

EXHIBIT II-4
KEY EVENTS WHICH OCCURRED FROM
0811 - 0815 INSIDE ENTRANCE REACH CHANNEL

TIME	EVENTS
0811	Navigator recommends slowing to "bare steerageway"; the ship is **four** minutes ahead of schedule. OOD concurs.
	CO does not hear order to slow the ship
0812	"Skunk Z" (URDULIZ) bears 238 degrees, 1500 yards and has right bearing drift.
0813	Bridge Liaison reports TOP holds ship 25 yards right of track. No set and drift calculations made.
	TOP's fix is calculated using four-sided figure; Piloting Officer's position placed the ship 75 yards right of track, vice the 25 reported.
	USS *GLENARD P. LIPSCOMB* (SSN 678) contacts *EISENHOWER* for port to port passage in Entrance Reach Channel; it is granted by the OOD.
	H-46 lifts off, degrading communications.
0814	CO and COMCRUDESGRU TWELVE discuss SECNAV's visit. URDULIZ is clearly visible.
0815	Ship passes green buoy 1 to port; Navigation Officer relieves Navigation Plotter; his initial attempt to obtain a fix fails.
	URDULIZ fades from radar 1200 yards from the *EISENHOWER*.
	Bridge personnel consider URDULIZ at anchor.
	While the bridge navigation team fails to obtain a visual fix, no recommendation is made by the Navigator to shift the lead back to TOP.
	Status board reveals URDULIZ is CBDR

Source: National Transportation Safety Board Investigation

After the reports from TOP and their recommendation to continue turning left to course 220°, the OOD ordered and the Conning Officer executed a course change to 225°. The CO was

informed by the OOD that the ship's speed was 3 knots and the CO **immediately ordered** it increased to 5 knots to obtain more maneuvering control.

COMCRUDESGRU TWELVE departed the bridge at approximately 0817; he noted the URDULIZ' position off the starboard bow and heard the order to come left. He assumed the bridge team was aware of URDULIZ' position and was coming left to clear the anchored ship. He did not feel that *EISENHOWER* was standing into danger. The deck log notes the increase in speed and course change to have occurred at 0817. Between 0811-0817 the ship travelled approximately 1,085 yards, an average speed of 5.4 knots.

At 0817, the bridge navigation team obtained the first good visual fix since 0759. The fix placed the position of the ship **inside ZULU anchorage**. At 0817 the USS *GLENARD P. LIPSCOMB* passed abeam of the ship in the **center** of the channel, 225 yards northwest of Elizabeth River buoy 1. Other than the recommendations from the Piloting Officer to come to 225° and then continue to 220°, **no recommendations were made by the OOD, JOOD, Navigator, or the Navigation Officer**, or any members of the radar navigation team to avoid the URDULIZ. Any evasive action at this point could have possibly prevented a collision.

At 0818 the Conning Officer ordered left 15 degrees rudder. Immediately thereafter, the CO assumed the Conn and increased rudder to left 30 degrees. At 0819 the bow of the

EISENHOWER crossed the bow of the URDULIZ. The CO, OOD, and Navigator did not consider a collision imminent until after the bow of the ship had crossed the bow of the URDULIZ. The ship was now in "extremis"! The only way to avoid a collision at this point was for both ships to execute an evasive maneuver. Since the URDULIZ was at anchor with no way on, a collision was inevitable.

The CO moved to AUX Conn[10] while continuing to give rudder orders. The CO ordered right 30 degrees rudder, in order to swing the stern of the ship to port to avoid the URDULIZ. The OOD ordered the Boatswain's Mate of the Watch (BMOW) to sound the collision alarm and warn all personnel to stand clear of the starboard side of the ship. At 0821, as indicated in the deck log, the *EISENHOWER* collided with the bow of the URDULIZ. The collision was hardly felt by many on the ship, and the only indication of trouble was the sounding of the collision alarm. A summary of the events that took place from 0816 until the collision is shown in **Exhibit II-5**.

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[10]An auxiliary conning position off the starboard bridge wing used when conning alongside other ships during underway replenishments. This station provides a better vantage point for conning officers.

EXHIBIT II-5
KEY EVENTS WHICH OCCURRED IN THE FIVE MINUTES PRIOR TO THE COLLISION

TIME	EVENTS
0816	Bridge Liaison reports TOP holds ship 200 yards right of track.
	Piloting Officer switches nearest hazard to navigation to URDULIZ when he learns of her position. He recommends coming left to 225 degrees.
	Piloting Officer then recommends continuing to 220 degrees.
	OOD orders Conn to come to **225** degrees.
0817	CO learns of ship's speed and immediately increases speed to five knots.
	COMCRUDESGRU TWELVE leaves bridge; he does not feel the *EISENHOWER* is standing into danger.
	Bridge Navigation team obtains first visual fix since 0759. The fix places the ship **inside ZULU anchorage**.
	USS *GLENARD P. LIPSCOMB* passes down the port beam in the center of the channel.
	No action is taken by the OOD to stop the ship prior to her bow crossing the URDULIZ.
0818	Conn orders left 15 degrees rudder; CO assumes the conn and increases rudder to left 30.
0819	The bow of the *EISENHOWER* crosses the bow of the URDULIZ.
	CO moves to AUX Conn; he orders right 30 degrees rudder to swing the stern.
	OOD orders BMOW to sound the collision alarm.
	CO orders right 35 degrees then left 35 degrees rudder.
0821	The *EISENHOWER* collides with the URDULIZ.

Source: National Transportation Safety Board Investigation

Had the CO not assumed the conn from the JOOD when he did, damage to both ships may have been extensive. His experience

and composure were indispensable factors that minimized the effects of the collision. The OOD recommended, after the bows of the two ships had crossed and an "extremis" situation was reached, an "emergency full astern" bell. The CO rejected this recommendation; a backing bell, he judged, would only exacerbate the situation. Deceleration tables for the *EISENHOWER*, however, showed that at a speed of five knots the ship could have been stopped in approximately 120 yards or 48 seconds after answering an emergency backing bell [Ref. 4:p. 3].

Following the collision, the CO ordered "all stop". The deck log indicates the order was given, yet neither the Helm Safety Officer[11], nor the Lee Helm heard the CO give the order from AUX Conn. The ship proceeded an additional 75 yards, entangled with the bow of the URDULIZ, before the order was acted upon. This delay in answering the "all stop" bell induced more damage to both ships. The two ships remained joined for approximately 12 minutes; during this period the XO and First Lieutenant surveyed the *EISENHOWER's* starboard side for damage. The XO reported to the CO that there were no injuries to personnel, no fuel leaks, no damage to ordnance, and a class "C" fire[12] in a power panel had been

[11]A position filled by a qualified conning officer to monitor the actions of the helm and lee helmsmen.

[12]A class of fire that is electrical in nature; it must be extinguished with carbon dioxide (CO_2).

extinguished. At 0835, the Docking Pilot arrived on the bridge of the *EISENHOWER* to pilot the ship under tugboat power back to Pier 12. The ship arrived at Pier 12 at 0945 - one hour and 24 minutes after the collision.

According to the URDULIZ' charts, her bow was approximately 200 yards from the southern boundary of ZULU anchorage at the time of the collision. The *EISENHOWER*, therefore, was at least **200 yards right** of her intended track in the Entrance Reach Channel. The damage, however, was complete; the time for investigation was now at hand.

III. THE COLLISION INVESTIGATIONS

A. NTSB INVESTIGATION

The NTSB is an independent Federal agency dedicated to promoting aviation, railroad, highway, marine, pipeline, and hazardous materials safety. The agency is mandated by the Independent Safety Board Act of 1974 to investigate transportation accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation.[Ref. 2:p. i]

The safety board makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews. The NTSB's report interprets the collision of the URDULIZ by the USS *DWIGHT D. EISENHOWER* and the safety issues involved in the accident. Recommendations that addressed these safety issues were presented to the United States Coast Guard and the United States Navy.[Ref. 2:p. vi]

The NTSB was notified of the collision approximately two hours after it occurred. Safety Board investigators were dispatched on 29 August 1988 to Norfolk, Virginia. The NTSB and the Coast Guard agreed that it would be in the public interest for the Safety Board to direct the investigation with

Coast Guard participation. The agreement was made pursuant to the Memorandum of Understanding dated 28 September 1981 between the two agencies.[Ref. 2:p. 41]

The investigation's focus was centered on the discussion of four main safety issues involved in the collision. [Ref. 2:p. v]

1. The pilot employment practices of the U.S. Navy for its vessels transiting Norfolk harbor.
2. The location of the anchored URDULIZ in relation to the channel.
3. The U.S. Navy harbor control of naval vessel traffic.
4. The Entrance Reach Channel width and navigational aids.

Each of these issues will be discussed along with other probable causes cited by the NTSB.

1. Pilot Employment Practices

According to the NTSB's report,

> ...the state of Virginia requires foreign vessels, or U.S. registered vessels departing on or returning from a foreign voyage to engage the services of a state pilot. The Federal government requires a Coast Guard licensed pilot on any U.S. commercial vessel of more than 1,600 gross tons or more on a coastwise voyage while the vessel is in U.S. "pilotage waters." The master of a U.S. commercial vessel can satisfy this requirement by employing a state pilot with a Federal license or an independent Federally licensed pilot, or by utilizing a member of the vessel's crew who has been issued a Coast Guard pilot's license for those waters. **Federal law excludes military** and other public vessels from state and federal pilot requirements.

Naval Station Norfolk now and at the time of the collision contracts the services of pilots within the Hampton Roads waterways. The Federal pilot association, Cheaspeake and Interstate Pilots (C&IP), reported that between November 1985 and November 1988 about 292 vessels had been piloted, most of which had drafts greater than 25 feet. The waterways around NOB and the Craney Island Fuel Depot are active and crowded; the Commander, Naval Station Norfolk reported in the investigation that 2,028 Naval vessels arrived or departed through the waterways surrounding NOB in a one year period [Ref. 2:p.22]. The investigation provided evidence that the norm for Navy vessels transiting Hampton Roads was to not use the services of pilots between the entrance to Chesapeake Bay and buoy 3 in Entrance Reach Channel. The utilization of pilots in this area was viewed by navy ships as a reflection that "...the vessel's crew had less than a professional shiphandling ability."[Ref. 2:p. 21]

Interviewing the *EISENHOWER*'s Navigator, the NTSB discovered that the Navy rarely embarked pilots going in or out of Norfolk; however, the Navigator had discussed the idea of a pilot with the CO. According to the Navigator, he reported what he had learned on a visit to the Cape Henry Virginia Pilot Association (VPA) Station to the CO and what their capabilities were and he (the CO) said, "well, I don't think we need a pilot, but **really I'll leave that to you.** If you really feel strongly that we need a pilot, we'll get a

pilot." After thinking about the decision for a period of time, the Navigator determined that they did not need a pilot.

The CO's unfamiliarity with the Navy's policy on pilots was revealed in his NTSB interview. When asked about the Navy's policy in utilizing pilots, the CO replied: "I really couldn't answer what the Navy policy is, I really don't know." The investigation summarized the CO's responsibility as it is presented in Navy Regulations - Title 32 of the Code of Federal Regulations (CFR) Subpart 700.754.[Ref. 2:p. 23]

Title 32 CFR 700.754: Pilotage

(a) The Commanding Officer shall:
(1) Pilot the ship under all ordinary circumstances, but he may employ pilots whenever in his judgment such employment is prudent
(2) Not call a pilot on board until the ship is ready to proceed.
(3) Not retain a pilot on board after the ship has reached her destination or point where a pilot is no longer required.
(4) Give preference to licensed pilots.
(5) Pay pilots no more than the logical rates.

(b) A pilot is merely an **adviser** to the commanding officer. His presence on board **shall not** relieve the CO or any of his subordinates from their responsibility for the proper performance of the duties with which they may be charged concerning the navigation and handling of the ship.

The practice of employing pilots in Hampton Roads by the Navy was not enforced policy. Navy COs had the authority to decide whether they required a pilot; there were no strict regulations for their use. Since Commanding Officers did not want to be considered incapable of handling their own ships,

their employment of pilots was quite low. Of the 2,082 ship movements in and out of Norfolk from 01 October 1987 to 30 September 1988 (a one year period), less than five percent of navy ships employed pilots [Ref. 2:p. 16]. This was a Norfolk NOB quality control problem.

2. The URDULIZ' Anchorage

The pertinent anchorages in the Entrance Reach Channel at the time of the collision are labelled as shown in **Figure III-1.** Anchorage "A" was the Quarantine, Customs, and Immigration Anchorage for commercial vessels and was also used by deep drafts waiting to load or unload their cargo. The sizable anchorage included the 1,500 foot - radius berth "Z" in which URDULIZ was anchored. The southern edge of berth "Z" was located 600 feet north of the northern edge of Entrance Reach Channel **before** the channel was narrowed. After the channel was narrowed, the southern edge was only 300 feet from the channel edge. In fact, the southern boundary of Anchorage "A" was also the northern edge of the previous Entrance Reach Channel, yet was not marked by any navigational buoys. The explanation for the Coast Guard's decision not to place buoys near the anchorage was explained as follows: "...when you put buoys near an anchorage they get run over and serve only as a hazard to navigation" [Ref.2:p. 34].

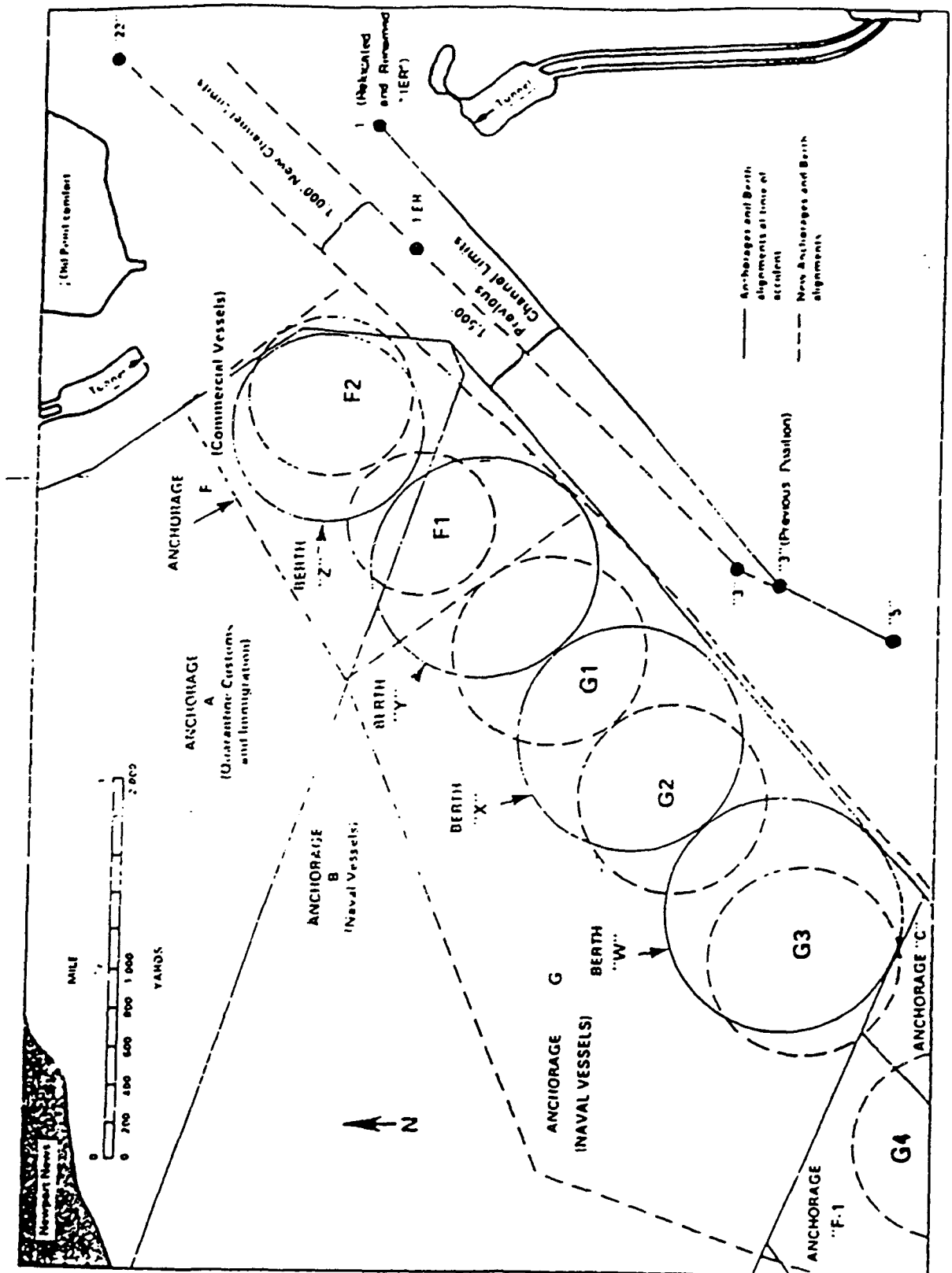

Figure III-1 Anchorages adjacent to Entrance Reach Channel

In 1984, the Coast Guard had proposed intended changes for the Hampton Roads waterways around the Norfolk Naval Base. These modifications were necessary due to the construction of the Newport News Bridge-Tunnel. To accommodate this construction, the **widening** and **deepening** of the channel was initiated in 1987. This widening of the channel precipitated the adoption of new buoy and channel alignments. Subsequent to these changes, the Coast Guard renamed a segment of Anchorage "A" to "F" and berth "Z" to "F2".[Ref. 2:p. 21] As shown in **Figure III-1**, the southern edge of Anchorage "F" was moved north and aligned with the new, northern edge of Entrance Reach Channel. Also, the southern boundary of new berth "F2" was nearly the same as the previous berth "Z". These changes to the affected anchorages became effective on 08 February 1989. The Coast Guard intended these changes to widen the channel, yet in the end, the most travelled stretch of Entrance Reach Channel (around the anchorages) was narrowed by repositioning the present buoy alignment.

As the investigation pointed out, it is difficult for a any conning team to calculate visually the new northern edge of the channel. This was because the Coast Guard had not established a navigational aid in the 3.2 nautical miles between buoy 22 on the eastern end of the channel and buoy 2 on the western end of the channel [Ref.2:p. 34]. The Coast Guard considered the depth of the anchorages (greater than 50 feet in most places) and determined that ships would not

consider these areas outside the channel available for maneuvering. Had they simply devised a buoy system for the anchorages, the Coast Guard could have avoided any misinterpretation by ship navigation teams entering or departing the channel. The proper marking of the northern edge of the channel, or the southern edge of the anchorages, would have greatly decreased the ambiguity of a ship's navigation team, yet the Coast Guard failed to consider this factor.

The relocation of the channel's northern boundary in conjunction with the absence of a methodical buoy system allowed the *EISENHOWER* bridge team to become careless in their attention to the ship's lateral movement through the water. Had an appropriate buoy system been in place, the bridge team may have noticed the deviation from its intended course and took corrective action much earlier, possibly avoiding the collision.

3. U.S. Navy Harbor Control in Entrance Reach Channel

The Port Operations Department in Norfolk is the responsible agent for scheduling the movement of all naval vessels at NOB and those vessels transiting Hampton Roads. Requirements for the "Movement of Ships at a Naval Station" are set forth in U.S. Navy Regulations:[Ref. 2:p. 24]

(1) No ship or craft shall be moved or undergo dock trials during its stay at a naval station, except by the approval or direction of the commanding officer of such station.

(2) A ship arriving at, or departing from, a naval station shall be furnished such assistance, including tugs, when available, as in the opinion of the commanding officer of the naval station or the ship may be necessary for her safe handling.

These directives suggest that all ship movements were carefully coordinated within Port Operations and also with the naval station. This was not necessarily the case. The USS *GLENARD P. LIPSCOMB* was underway in the channel at the same time as the *EISENHOWER*. With appropriate forethought the Port Operations schedulers could have avoided having two vessels of deep displacement in the Entrance Reach Channel at its narrowest point. The NTSB investigation proceeded to point out that:

> ...Port Operations should control naval vessel traffic so that deep draft vessels (vessels with a draft of 25 feet or more) do not encounter another deep draft naval vessel when transiting the Entrance Reach Channel [Ref. 2:p. 35].

This is particularly important because of the *EISENHOWER's* "shadow zones" and her 36 foot draft. The shadow zones created by the *EISENHOWER's* size are depicted in **Figure III-2**. The inability of the bridge team to continually monitor the port-to-port passage of the *LIPSCOMB* factored in the collision. According to the investigation,

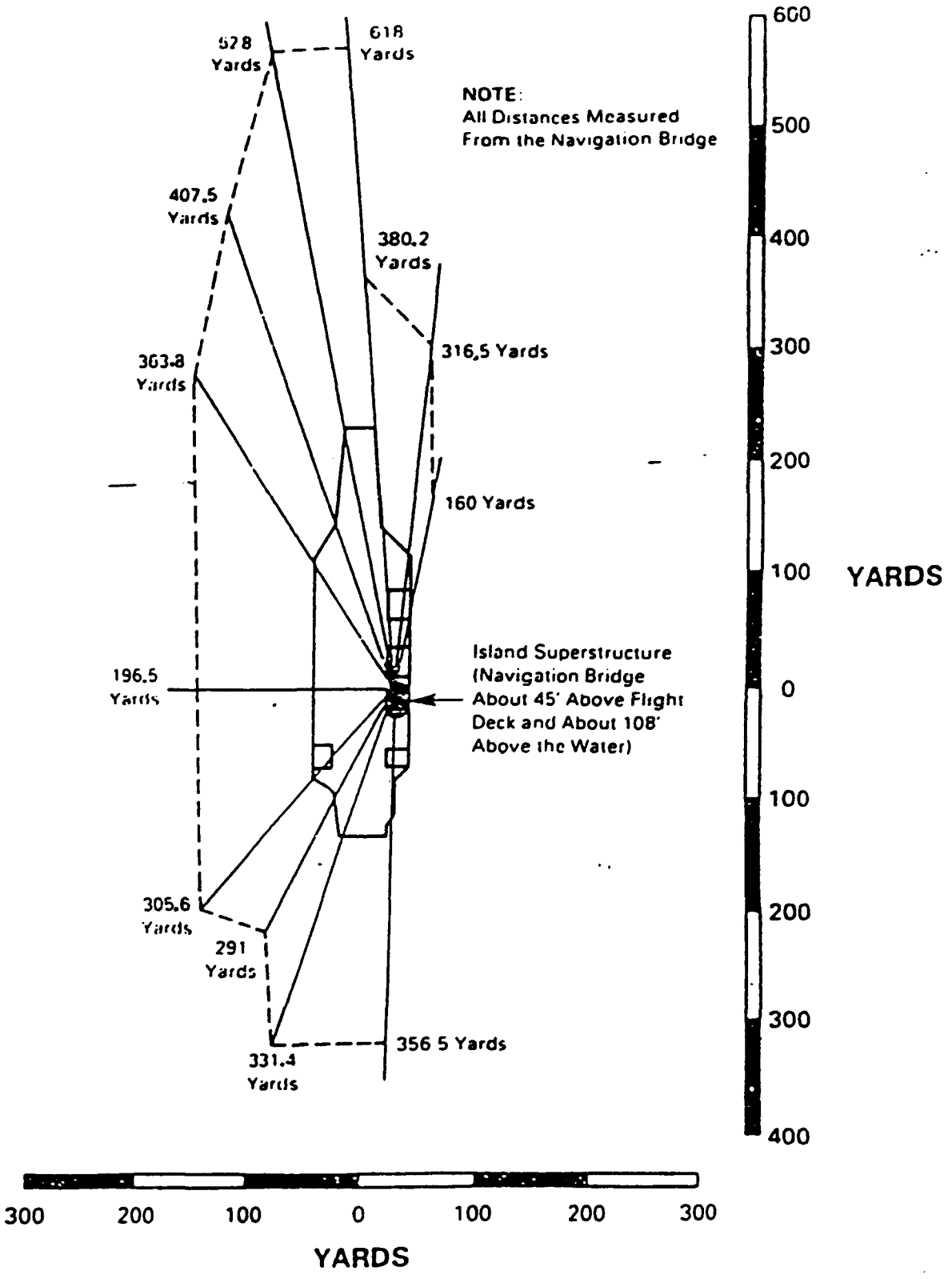

Figure III-2 Shadow zones measured from the bridge of the EISENHOWER

> If the *EISENHOWER* had followed its planned track, with its bridge on the northern edge of the old Entrance Reach Channel (700 feet wide at buoy 1ER after the changes) its flight deck would have "shadowed" approximately 590 feet of channel on its port beam, leaving about 110 feet of the channel visible from the navigation bridge to buoy 1ER and the southern side of the new Entrance Reach Channel. Had the submarine followed a trackline of about 100 - 150 feet to the left of buoy 1ER, the large shadow zone on the port side of the *EISENHOWER* prevents a continuous view of a vessel with a low profile or a small vessel, if it passes too close, especially a vessel such as a submarine. [Ref. 2:p. 21]

As stated in the investigation, "...arrivals and departure times are still coordinated with Port Operations for shoreside services and to avoid conflict with other naval vessel movements in the harbor."[Ref. 2:p. 25] This was not the case on the day of the collision. No attempt was made by the Port Operations Department to coordinate the arrival of the Navy's deepest draft combatant, with the departure of a submarine. The meeting of the two vessels narrowed the already constricted waterway to a point where the *EISENHOWER* had practically no maneuvering room. Without ample room to pilot the 95,000 ton ship, the likelihood of any free navigation to correct an error was systematically reduced.

The Coast Guard had an established regular navigation area (RNA) to restrict navigation near large naval vessels by other vessels. This RNA is part of the CFR, Title 33 Paragraph 165.501(d)(11). It requires that:

> ...no vessel may, without the permission of the Coast Guard, come within 500 yards from a naval aircraft carrier or other large naval vessel, which is restricted in its ability to maneuver in confined waters,...transiting the

> Elizabeth River between the NOB and the Norfolk Naval Shipyard....[Ref. 2:p. 25]

The requirement is straightforward in its wording, yet was not fully complied with on 29 August 1988, and the NTSB investigation viewed this as non-contributory to the collision.

4. The Entrance Reach Channel Width and Navigational Aids

During December 1988, the Army Corps of Engineers (COE) completed channel dredgings at Thimble Shoal, Entrance Reach, Newport News, and Norfolk Harbor Reach. The COE dredged 650 feet of the outbound side of the 1,000 foot Entrance Reach Channel to a depth of 50 feet, and the remaining 350 feet of the inbound side to a depth of 45 feet. Also, the Channel was reduced in depth from 1,500 to 1,000 feet.[Ref. 2:p. 19]

Entrance Reach Channel is located between Old Point Comfort and Fort Wool on the east and Sewells Point in the west. The southern side of the channel used to be marked with Elizabeth River Channel Lighted Horn Buoy (LHB) "1" (buoy 1) near Fort Wool and the Elizabeth River Channel Lighted Buoy "3" (buoy 3) northwest of Sewells Point (This is depicted in **Figure III-3**). A line drawn between the two buoys (1 and 3) delineated the southern edge of the channel.

The northern side of the channel was located at the southern edge of Anchorages "A" (berth "Z") and "B" (berths "X", "Y", and "W") and on a line between the Naval Ordnance

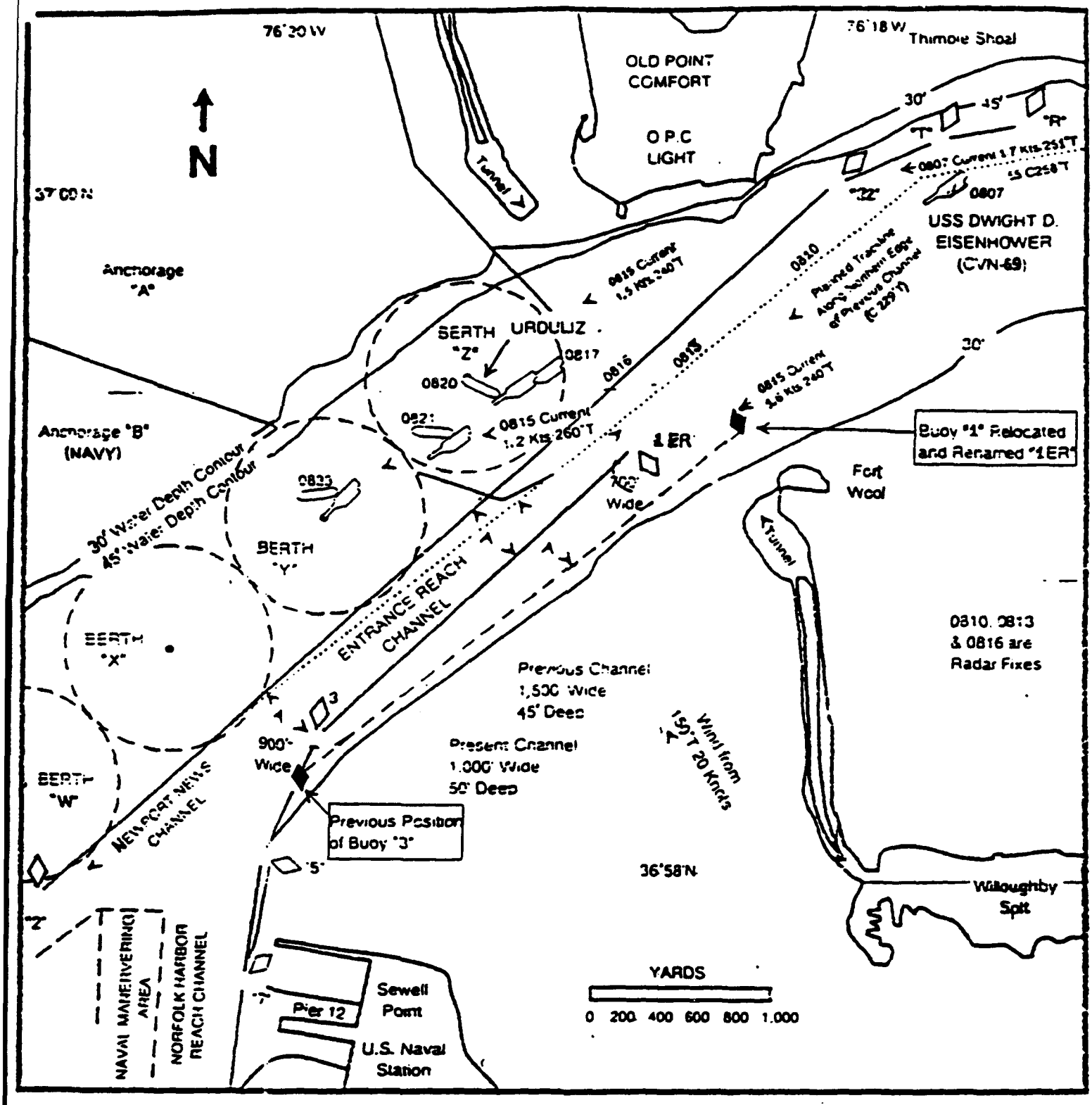

Figure III-3 Detailed chart of the accident site

Lighted Buoy (buoy "T") east of Old Point Comfort and the Newport News Channel Lighted Buoy "2" (buoy 2). This was a distance of approximately 3.5 nautical miles (nm). [Ref. 2:p. 19]

In early 1988, the Thimble Shoal Lighted Buoy "22" (buoy 22) was repositioned close to the eastern side of Old Point Comfort. This created a "hole" in the system; now, there were no buoys between buoy 22 and buoy 2 on the "new" northern side of Entrance Reach Channel, a distance of 3.2 nm. When the Coast Guard was asked why this was permitted, the witness replied, "...when you put buoys near an anchorage, they get run over and they serve only as a hazard to navigation." If an arriving ship followed a course on the northern side of the channel that corresponded to a line drawn between buoys 22 and 2, it would encroach the southern edge of Anchorage "A" and "B", thereby transiting through the anchorage. [Ref. 2:p. 19]

During 1988, buoy 3, also located on the southern side of the channel was repositioned 200 yards north, on the 50 foot water contour curve. Buoy 1, also located on the south side of the Entrance Reach Channel, was relocated 700 yards to the west and renamed buoy 1ER. These changes reduced the width of the channel by 500 feet. The width at the opening to Entrance Reach Channel was now 1,000 feet vice the 1,500 it had been before the "widening and deepening" project. The channel "upgrade" also decreased the distance between the

southern edge of Anchorages "A" and "B" to 700 feet at buoy 1ER and 900 feet near buoy 3. The actual width, therefore, varied depending on where a ship was located in the channel. As the CO of the *EISENHOWER* testified, "...there's not enough room for two ships to pass. Not carrier-size ships or a carrier and a submarine."[Ref. 2:p. 20]

This lack of foresight by the Coast Guard prompted the bridge piloting team of the *EISENHOWER* to rely on their "seaman's eye" to determine their position in the channel. Had the northern edge of the channel been clearly delineated with a buoy system, the bridge team could have used the natural range provided by the buoys to estimate their position in the channel.

The investigation did not agree with the Coast Guard's rationale that placing buoys near an anchorage resulted in increased hazards to navigation. The NTSB believed that the northern boundary of Entrance Reach Channel must be marked with additional buoys to assist conning crews of ships in determining the movement of their ship and the channel's limits.[Ref. 2:p. 35]

5. NTSB Recommendations

The NTSB, as a result of the investigation, supplied the following recommendations to the U.S. Navy:

- Provide in an appropriate Navy directive, guidance and requirements to COs of vessels about the use of state and Federal pilots, considering such areas as changed harbor configurations, crew experience in transiting the harbor,

length of time since last transit of the harbor, congestion or restriction of the waterway to be transited, and the size of the vessel.

- Develop and implement a bridge watch team management and teamwork training program for ship COs, navigators, and other bridge navigation personnel.
- Require the Norfolk Naval Station to schedule and control naval traffic departing or arriving, so that no deep draft naval vessels meet in the Entrance Reach Channel.
- Request the Coast Guard extend the RNA to include the Entrance Reach Channel for aircraft carriers and other large naval vessels. (refer to p. 31)
- Establish a newsletter that provides comprehensive vessel accident information and disseminate it to personnel in command, navigation, and other shiphandling billets.
- Disseminate the NTSB report to COs and navigation department personnel of all aircraft carriers in the fleet.[Ref. 2:p. 39]

The NTSB also recommended that the Coast Guard "...establish additional buoys on the northern side of Entrance Reach Channel to delineate the channel limits."[Ref. 2:p. 40]

As can be seen from the NTSB investigation, the underlying factor was to establish probable cause for the collision. The U.S. Navy JAG investigation's underlying concern was to establish and determine personal blame for the collision.

B. U.S. NAVY JAG INVESTIGATION

The Navy's investigation into the *EISENHOWER* collision began on 30 August 1988. The investigation was conducted by the ranking Norfolk JAG Officer, Rear Admiral Bernsen. He received administrative assistance from a team of five

officers and two enlisted personnel. The investigation was completed and forwarded to COMNAVAIRLANT on 19 September 1988.

The underpinning of the Navy's investigation rested in the written statements of the relevant personnel implicated in the collision. Based on those statements, secondary questions were developed by the investigating officer to further clarify certain areas. Subsequent to a review of the written responses, selected personnel were personally interviewed to acquire additional information.[Ref. 1:p. iv]

Since the Navy's investigation was originated, developed, and finalized prior to the NTSB investigation, the chief considerations of the Navy JAG investigation were to determine accountability and to take prompt, punitive action against those relevant officers and enlisted personnel; also, timeliness was ensured to assist attorneys in litigation matters with the Spanish government. A majority of the evidence supplied in the JAG investigation is identical to the NTSB's, therefore, such information will not be reproduced unless relevant.

1. Meteorological Conditions at the Time of the Collision

The effect of the currents and wind was emphasized in the JAG investigation was not in the NTSB investigation. The *EISENHOWER*'s Navigator, who knew the forecasted tidal currents, should have exercised caution in determining his intended track; he did not. The following table (**TABLE III-1**)

provides the tidal currents used by the Navigator in laying out his track. Considering this a significant part of the evidence, the JAG Officer also calculated these currents for the morning of the collision and were included in the JAG investigation.

TABLE III-1
TIDAL CURRENTS FOR THE HAMPTON ROADS AREA FOR 29 AUGUST 1988

TIME	STATE OF CURRENT	SPEED	DIRECTION
	EAST OF OLD POINT COMFORT (OPC)		
0421	SLACK WATER	0.0 KTS	---
0807	FLOOD	1.7 KTS	251°T
0931	MAXIMUM FLOOD	2.2 KTS	251°T
	SOUTH OF OPC		
0646	SLACK WATER	0.0 KTS	---
0815	FLOOD	1.5 KTS	240°T
0938	MAXIMUM FLOOD	2.7 KTS	240°T
	NORTHWEST OF FORT WOOL		
0614	SLACK WATER	0.0 KTS	---
0815	FLOOD	1.6 KTS	240°T
0851	MAXIMUM FLOOD	2.1 KTS	240°T
	MID-CHANNEL AT OPC		
0646	SLACK WATER	0.0 KTS	---
0815	FLOOD	1.2 KTS	260°T
0951	MAXIMUM FLOOD	2.5 KTS	260°T

Source: U.S. Navy JAG Investigation

As shown in **TABLE III-1**, only one current was applicable the morning of the collision, yet there are two types: flood and ebb. A flood current is the flow of the current **from** the ocean or sea, while an ebb current is the flow of the current **to** the ocean or sea. During the ***EISENHOWER***'s entire transit of the Hampton Roads channels, the currents were in a flood state. The Navigator should have realized that in this state the current would always be at the ship's port quarter or port beam in Entrance Reach Channel, complicating any type of slow maneuvering within the channel. This, along with the true wind blowing from the southeast, or more accurately off the ship's port beam, produced an effect that left a majority of the ***EISENHOWER***'s maneuvering control to the forces of nature. The ***EISENHOWER***'s bridge team did not make necessary corrections in regard to the effects of the wind and the current and by doing so allowed the ship to stand into danger, resulting in a collision. What is most perplexing is that the information for these natural forces was readily available (tidal current calculations and updated true winds whenever required), but not employed by any of the key bridge navigation personnel (Navigator, OOD, Chief Quartermaster, Navigation Plotter, or the Piloting Officer in TOP) in transiting the channel.

2. Opinions from the JAG Investigation

The investigation did produce numerous opinions on the reasons for the collision, however, only a few will be presented. The weight of the JAG investigation lay heavily on the errors made by the bridge team, more specifically the CO, Navigator, and the OOD. The OOD, the investigation pointed out, had not previously acted as sea and anchor OOD, and that his normal position during sea and anchor evolutions was Navigation Officer.

The investigation found only two personnel on the bridge not fully qualified in their respective positions; one, as mentioned earlier, was the JOOD. In accordance with *EISENHOWER* policy, he needed to conn the ship into port to complete his JOOD qualifications. Also, the Quartermaster of the Watch (QMOW), a third class petty officer, had not completed his qualifications as QMOW in accordance with PQS NAVEDTRA 43492-2AQ2. Neither of these non-qualifications was a direct factor in the collision.[Ref. 1:p. 18]

An opinion was also expressed on the extended length (six months) away from Norfolk.[Ref. 1:p. 19]

> Since six months had passed since anyone in authority on the bridge or in TOP had entered or left the Port of Norfolk, their inherent familiarity with the navigational characteristics of the port was reduced. This was a contributing factor in the collision.

It was noted that the turnover brief between the *EISENHOWER* and the *KENNEDY* in the Mediterranean Sea was complete in its information about the buoy relocation and fully understood by

the CO, Navigator, and OOD (Assistant Navigator). Therefore, as the investigation revealed, one of the causes of the collision rested with the unfamiliarity of the channel by all bridge team personnel. Another finding by the JAG disclosed that the number of high level visitors (SECNAV, COMNAVAIRLANT, COMCRUDESGRU TWELVE) and non-essential personnel on the bridge, plus helicopter operations that continued until just four minutes prior to the collision **may have distracted** the bridge team. The investigation did not determine these factors to be causal to the collision.[Ref. 1:p. 17]

The investigation also expressed concern over the repositioning of Elizabeth River Buoys 1 and 3 in March 1988. By relocating these buoys, the Entrance Reach Channel width was effectively reduced by almost 500 feet, forcing incoming vessels to steam much closer to Anchorages "A" and "B" and berths "W", "X", "Y", and "Z".[Ref. 1:p. 17]

Along with the repositioning of the buoys, the outbound track of the submarine *LIPSCOMB*, which was in the center of the new channel, about 225 yards southeast of berth "Z", further narrowed the channel and the margin of safety for the safe navigation of the *EISENHOWER* [Ref. 1:p. 18].

Also, the URDULIZ was not anchored in the center of berth "Z", but in the southwest quadrant of the berth, her bow approximately 200 yards inside the anchorage circle. This, combined with the relocation of the buoys and the passing of the *LIPSCOMB*, reduced the overall width which the *EISENHOWER*

could safely sail to just under 400 yards. In a situation of high winds off the port beam and a flood current on the port quarter, the reduced width required zero navigation error by the bridge navigation team in the transit of Entrance Reach Channel. Even in a situation with favorable weather conditions, the channel width would have created a demanding sailing environment. The JAG investigation did consider this a contributing factor in the collision.[Ref. 1:p. 19]

Another interesting point verified the difficulty the bridge navigation team experienced in comprehending what was actually on their navigation charts. After the turn to course 229° at Old Point Comfort, evidence from the *EISENHOWER*'s navigation chart indicated that lines of bearing did, in fact, cross, and that the resulting estimated position showed the ship to be well right of track - as much as 400-600 yards. The Navigation Officer (the Chief Quartermaster) considered this to be an anomaly and did not give it proper attention. He may have determined, prior to relieving the Navigation Plotter, that none of the Plotter's previous marks were accurate and thus the confidence in his personnel was reduced. This failure to accurately interpret the data from the chart was a contributing factor in the collision.[Ref. 1:p. 21]

The investigation also concluded that information received from TOP and specifically the Piloting Officer was inadequate. His failure to assess the radar error caused by

radar land return proved to be critical; had he reported that the ship may have been as much as 175 yards right of track, a possibility supported by the radar plot, vice the 25 yards right of track he reported, the bridge team may have had time to correct their continued drift towards the northwest and the URDULIZ. Without good visual fixes and a reliance on the presumed accuracy of the radar fixes from TOP, those in authority (CO, Navigator, and OOD) failed to realize the danger to the ship. Even after the report at 0816 from TOP that the ship was 200 yards right of track, no immediate and significant corrective action was taken prior to the *EISENHOWER* crossing the URDULIZ' bow. At this point, the only way to avoid a collision was for both ships to maneuver. This failure by the bridge team was a contributing factor in the collision.[Ref. 1:p. 20]

The lack of maintaining a vigilant watch on the URDULIZ' bearing drift was also instrumental. The JOOW's position near the centerline alidade convinced the OOD that the JOOW had a continual watch on the URDULIZ. This was not the case. The JOOW usually operated the RAYCAS radar set to determine which contacts required the most attention. During the transit of Entrance Reach Channel, the RAYCAS was being operated by the navigation team to check bearings received from the outside bearing takers. The JOOW's job as he perceived it, "... was to stay out of the way and let things run on auto-pilot."[Ref. 1:p. 21]

The last time the OOD checked the bearing drift on URDULIZ, he determined that there was slight right bearing drift, and that URDULIZ would pass safely down the starboard side. Subsequent to that determination, neither the OOD, nor any bridge personnel attempted to verify bearing drift. The OOD's failure to maintain supervision of his watch team was a factor in the collision.[Ref. 1:p. 22]

The Navigator's role in the collision, as judged by the investigation, was twofold. First, he failed to recognize the rapidity which the *EISENHOWER* was being set to the northwest side of the channel. Based on his experience, he should have:[Ref. 1:p. 21]

- ascertained why good visual fixes were not being obtained by his navigation team for over 20 minutes;
- considered relieving the Navigation Plotter earlier and replacing him with the Chief Quartermaster/Navigation Officer;
- personally checked the accuracy of the information coming from TOP;
- forcefully made the CO aware of the navigation team not being able to obtain a good visual fix and the likelihood that the ship was being set;
- not recommended slowing to "bare steerageway", an order that only worsened the ship's control problem in the confined waterway.

Secondly, the Navigator did not perform his role as the ship's pilot. The safety of the course/intended track back to Pier 12 was his responsibility, yet he did not exercise caution in the development of that course. The expected tidal currents, expected weather conditions, and

schedule for pilot pickup were all known, yet the Navigator chose not to work any margin of error into the intended track computation. The CO had allowed the Navigator to make the decision on the use of a pilot prior to entering Thimble Shoal Channel, but the Navigator decided that the ship did not require one. The extended length of the *EISENHOWER's* deployment should have been enough to convince the Navigator to employ a pilot. In the end, the Navigator's complete failure to take some, or any, action prior to the collision was a definitive factor in the collision.[Ref. 1:p. 22]

As for the CO, the investigation concluded that he failed to recognize his ship was being set right of track. Given his experience and qualifications, the CO should have taken the following actions:[Ref. 1:p. 23]

- questioned why good visual fixes were not being obtained and insisted the Navigator confirm the positions reported by TOP;
- ordered bearing drift readings be taken to determine URDULIZ' drift rather than relying on "seaman's eye";
- requested the submarine *LIPSCOMB* stand clear, so as to provide his ship with more maneuvering room in clearing URDULIZ;
- being aware that the true wind was greater than 20 knots, considered calling for earlier arrival of tugs and a pilot;
- paid attention to the ordered speed of "bare steerageway" (3 kts).

As mentioned in the NTSB investigation, the CO was made aware by the 0816 report from TOP that his ship was 200 yards right of track.[Ref. 1:p. 23-24]

> **The CO ... failed to comprehend that *EISENHOWER* was standing into danger, and failed to take immediate and prudent action to stop the ship or maneuver so as to avoid collision. Such action might have included letting go the ready anchor, ordering all back emergency or some other rudder and engine order combination to avoid collision with URDULIZ. The CO's failure to take such action was the primary factor in the collision. The ultimate responsibility for the collision rests with the CO. It was his error in judgment that allowed *EISENHOWER* to proceed beyond the point of extremis and collide with an anchored vessel.**

The JAG investigation's recommendations for discipline and for changes in the Hampton Roads area waterways follow.

3. U.S. Navy JAG Corps Recommendations

The following recommendations were handed down from the U.S. Navy JAG Corps Investigation:

1. That the CO be charged with violation of Article 110, Uniform Code of Military Justice, Negligent Hazarding of a Naval Vessel, for failing to recognize the potential for collision brought about by attempting to pass URDULIZ close aboard without sufficient regard for the effects of wind and current and for failing to take immediate and prudent actions to avoid a collision. If found guilty, it is further recommended he be awarded a punitive letter of reprimand.

2. That the Navigator be charged with violation of Article 92, Dereliction of Duty, for his failure to ascertain the reasons why good visual fixes were not being reported by the bridge navigation team for a period of about 20 minutes, his failure to turn the navigation lead over to TOP, his failure to personally check the accuracy of the radar navigation plot, his failure to exercise prudent and good seamanship when he recommended slowing to "bare steerageway" under wind and current conditions known to cause rapid and serious set and drift, and his failure to properly inform the CO that good visual fixes were not being obtained by the bridge navigation team. If found guilty, it is further recommended he be awarded a punitive letter of reprimand.

3. That the OOD be charged with violation of Article 92, Dereliction of Duty, for his failure to properly supervise the JOOW and ensure that bearing drift on URDULIZ was being ascertained at regular intervals in a proper manner. If found guilty, it is further recommended he be awarded a non-punitive letter of caution.

4. That the Navigation Officer (Chief Quartermaster) be charged with violation of Article 92, Dereliction of Duty, for his failure to recognize and report that the visual bearings obtained and plotted by the bridge navigation team were essentially correct and that the estimated positions that were being plotted placed the *EISENHOWER* considerably right of the planned Entrance Reach track. If found guilty, it is further recommended he be awarded a non-punitive letter of caution.

5. That the JOOW be awarded a non-punitive letter of caution, for his failure to adequately monitor the bearing drift of URDULIZ in accordance with the provisions of the Commanding Officer's Standing Orders.

6. That the Piloting Officer be awarded a non-punitive letter of caution, for his failure to recognize and report that the 0813 radar fix was in effect an estimated position and, depending on interpretation, could have placed the ship as much as 175 yards to the right of track.

7. That the Commander-in-Chief, U.S. Atlantic Fleet (CINCLANTFLT) officially and formally review the various U.S. Coast Guard and Army COE ongoing programs modifying the Hampton Roads channels and anchorages; this evaluation to include the effect narrowing the channels has had and what effect deepening to 55 feet and further narrowing the channel will have on naval ship traffic in the Hampton Roads area. It is further recommended that the Commander Naval Base, Norfolk (COMNAVBASE) as the Area Commander, be designated to act as CINCLANTFLT's agent in the review; additional representation to be provided by COMNAVAIRLANT, COMNAVSURFLANT, COMSUBLANT, COMSECONDFLT, and COMTRALANT.

8. That in view of the changes already in effect restricting channel width in key areas of the Hampton Roads channel system that Type Commanders (TYCOMS) and COMSECONDFLT be directed to incorporate guidance in their standing orders requiring capital ships to utilize pilot services from the entrance to Chesapeake Bay to

the pier when returning to the Norfolk area after an extended deployment of three months or more.

9. That the U.S. Coast Guard be requested to ensure that commercial ships anchor close to the center of berths "X", "Y", and "Z" and further that the VPA be apprised of this request.

10. That the *EISENHOWER* discontinue the practice of allowing non-qualified JOOD's to conn the ship during sea and anchor detail in order to achieve qualifications. The JOOD should be considered under instruction until fully qualified.

11. That JOOW qualification requirements on *EISENHOWER* include in-depth training and hands on practical experience on the RAYCAS. As a minimum, a bridge watch officer should be able to determine closest point of approach (CPA), course, speed, bearing drift, and course and speed to avoid collision. Additionally, RAYCAS should be available to the JOOW during sea and anchor detail.

12. That a standing *EISENHOWER* Sea and Anchor detail for bridge watch officers be established.

13. That internal communications policy aboard *EISENHOWER* be reviewed to ensure that shipping information is available at all times to the Piloting Officer.

14. That every surface contact be plotted on *EISENHOWER*'s Dead Reckoning Table (DRT) from time of designation until the contact is "scrubbed" by the OOD. [Ref. 1:p. 24-26]

The recommendations proposed by the Navy JAG investigation for discipline of the CO, Navigator, OOD, JOOW, Navigation Officer, and Piloting Officer were all carried out at through non-judicial punishment at Admiral's Mast in September 1988. The careers of the CO and Navigator were negatively influenced by the decisions rendered at Admiral's Mast. The CO was assigned to a position as Professor of Naval Science (PNS) at a Midwest college. The CO was in a position

to achieve flag rank upon his successful transfer from the *EISENHOWER*; he was never selected for admiral and retired 2 years later. The Navigator was transferred to a shore billet at an operational aviation squadron; he was never selected for 0-6 (captain) or for command at sea and retired 3 years later.

As the investigation uncovered, the actions taken by the CO, Navigator, and bridge watch team were not sufficient to avoid collision with the URDULIZ. The ensuing chapter will build on these investigations and provide an additional interpretation of the circumstances surrounding the *EISENHOWER*'s transit of Entrance Reach Channel.

IV. ADDITIONAL ANALYSIS

In most cases, two descriptive investigations by two independent entities would be more than necessary to identify and evaluate the causes of the collision. However, the time invested to investigate the collision may have hampered the process. In the Navy's investigation, the period of time that elapsed from the initiation of the investigation to the final recommendations totalled less than one month (29 August to 19 September 1988). On the other hand, the NTSB investigation lasted over 16 months. Also, there was a striking difference in the content of the two investigations. Some factors, causal in this author's opinion, were not given due consideration in either investigation and are important to bring out. Without the proper identification of the causes, the solutions generated to avoid situations like this in the future can only be a partial panacea.

There were five factors, from this author's perspective that needed greater elaboration. The first three are management issues compatible with the points brought out by Perrow in his book Normal Accidents. The final two factors consider the role of Port Operations and the Coast Guard. This chapter will examine these factors which the author perceives as critical to the overall understanding of the *EISENHOWER* collision.

A. Bridge Watch Organization

The makeup of a bridge watch team is comprised of an OOD, JOOD/Conning Officer, and JOOW. As defined earlier, the OOD has overall responsibility during his watch for the ship's operations and movement. The CO vests his confidence and trust in the OOD to assist him in carrying out the duties of operating the Navy's largest naval vessel. The OOD's command relationship with the CO is stated in Navy Regulations, Article 1008: "Every person on board who is subject to the orders of the CO, except the XO, and those officers specified in Article 1009, shall be subordinate to the OOD." [Ref. 2:p. 24] However, the ultimate responsibility for any action taken, or not taken, by an OOD is the COs, yet that trust also dictates that an OOD be prepared to execute any and all initiative in a situation requiring prompt and immediate action. This trust is the foundation of all bridge teams; any breach of that trust by a watch team member jeopardizes the ship and, more importantly, the crew.

The organizational structure of bridge watch teams on the *EISENHOWER* must be identified as a factor in the collision. In Article 1009 of Navy Regulations, the relationship of the OOD to the Navigator is stated: "The navigation officer shall **advise** the OOD of a safe course to be steered and the OOD shall regard such advice as **sufficient** authority to change the course, but shall..." immediately report the change to the CO.[Ref. 2:p. 24] Nowhere in the article does it specify that

the OOD must concur with the Navigator's recommendation of course or speed changes. In this case, day watches were structured, by some OOD's, around the whims of the Navigator, and how he desired the ship to be operated, not navigated. This, in effect, took the CO's vested authority from the OOD and established him as a "parrot" for the Navigator's wishes. In many instances, this wresting of control from the OOD formed doubt among the watch team as to its role. The autonomy exercised by the Navigator usurped the duties and responsibilities of the OOD and contributed to making him a non-player in decisionmaking - challenging his reason for being qualified. This occurred on numerous occasions when particular OODs were on the bridge with the Navigator present. The Navigator's interference in OOD-related ship control scenarios forced those affected OODs to structure their watch to the Navigator's desires rather than maintaining the "big picture" of the surrounding environment.

In addition, reliance on the Navigator was a problem because his reasoning was, at times, illogical. OODs rarely questioned his authority, but his working knowledge of the basics in navigation and in piloting a large vessel were not the mark of a proficient shiphandler. On numerous occasions the Navigator would make a determination on how the ship should be handled in certain situations, yet the decision went against all traditional shiphandling practices.

Among the Navigator's unconventional habits: his propensity to navigate on the chart with the use of his fingers vice navigation dividers. Upon discovering the intended distance with his fingers, he would base the entire leg of that transit on the crudely estimated interval. This practice was not just used on open ocean transits, but it was employed entering into foreign anchorages where the consequences of anchoring within a certain distance (usually 3 NM) of land could create an international incident. The *EISENHOWER* is a nuclear carrier, and thus foreign governments require that the ship remain outside 3 NM for safety reasons. On one occasion, entering into Palma de Mallorca, Spain, the ship actually anchored too close and was "asked" by local authorities to pick up anchor and move farther out to sea [Ref. 8]. This is just one result of his "simplification" of navigational policies. In the end, the OOD's blind reliance on the Navigator's "knowledge" created a detrimental form of dependence.

The OOD, also the Assistant Navigator, was one of those officers who responded this way towards the Navigator. One of the main reasons why he concurred with the Navigator's decision to slow the ship to "bare steerageway" in Entrance Reach Channel was because the Navigator was his department head. He trusted the Navigator unfailingly, even though, as brought out in both investigations, the OOD was a "...capable and experienced shiphandler..." who could make his own

independent determination of the situation. The fact that the OOD was an excellent shiphandler and conning officer should have influenced his actions that morning. Proficiency in both the JOOD and OOD positions must be used to deal with precarious situations at sea. The OOD knew where the wind was blowing from (port beam) and was aware, from the entering port brief, of the expected tidal currents. So, why did he allow himself to be guided by the inexperience of the Navigator? Perhaps his own inexperience as a sea and anchor OOD played a major role.

The reason he was OOD that morning was due to his incessant desire to be the OOD when the ship came into Norfolk. As the Assistant Navigator and responsible for watchbill assignments, it was easy to give himself the assignment. Having never performed in that role, and wanting to show his boss (the Navigator) and the CO he had the ability to "bring the ship in", plus the proud distinction of being the entering port OOD, was more than enough reason for putting himself in the role. Allowing both men in those positions - a Navigator without navigational skills and an OOD without the prior experience was an absolute error in judgment by those in authority.

B. Non-essential Personnel on the Bridge

Throughout the NTSB and Navy JAG investigations the subject of non-essential personnel on the bridge surfaced.

However, the issue was never established as a contributory factor in the collision. Of the 3 officers on watch and the Helm Safety Officer, all pronounced, in interviews with the author, their disgust with the number of "oglers" on the bridge. The NTSB investigation estimated

> "...at least twenty crewmembers (CO, Navigator, OOD, JOOD, JOOW, TOP Officer Liaison, Navigation Officer, Navigation Plotter, visual bearing recorder, QMOW, 2 helmsmen, a lee helmsman, 2 visual bearing takers, and at least 5 sound-powered phone talkers connected to various stations throughout the ship. In addition, there were 6-8 "Tigers", news media representatives who interviewed the CO, and an **undetermined** number of other crewmembers on the bridge observing the activities."[Ref. 2:p. 6]

The usual number of personnel on the bridge during a routine underway watch never exceeded 15. On the morning of the collision the number ranged, based on accounts from those interviewed, between 36 and 45 personnel. Granted, the number of personnel would increase for an evolution like sea and anchor (3-4 additional phone talkers), but a three-fold increase created confusion and disorder for the bridge team. Not only was it difficult to hear, but it was difficult to actively move around on the bridge. As the ship drew nearer to the pier, the din on the bridge grew, prompting the OOD to request "silence on the bridge" three times [Refs. 5, 6, 7]. Not once did the OOD request personnel leave the bridge. During one other less eventful occasion, this same OOD had requested unauthorized personnel to depart the bridge.

Why did he not do the same the morning of the collision? One explanation is the presence of the media crews. Throwing people off the bridge would not have created the proper ambience, and may have drawn a negative response from the Navigator. The Navigator, however, was preoccupied, impressing his "Tigers" and the news media about the ship's exploits in the Mediterranean. Any outburst on the bridge would have drawn unwelcome attention. So, the OOD permitted the noise to grow to a point where orders had to be shouted and the CO, who was continually burdened with "bridge guests", could not hear the orders.

The arrival of COMCRUDESGRU TWELVE on the bridge just 7 minutes prior to the collision (0814) provided yet another distraction for the bridge watch team and the CO [Ref. 1:p. 12]. At this time the ship was still in a position to avert disaster. Proper attention and judicious action could well have prevented the collision. In two minutes (0816) the TOP report would show the ship to be 200 yards right of track and would eventually bring the watch team to a realization that the ship was standing into danger. By then, however, it was too late.

The distraction of the embarked flag officer entering the bridge, the noise on the bridge, and the OOD's refusal to take control of the situation generated an almost inescapable predicament. Still, there were ample opportunities for the

OOD, Navigator, JOOD, and JOOW to recognize the ship's state and make recommendations to avoid the URDULIZ.

C. The Role of the JOOD

One point not brought out in either investigation was the JOOD's ineffectiveness in assisting the OOD. Not only is the JOOD responsible for conning the ship, but he is the OOD's primary assistant. At no time did he ascertain the bearing drift of the URDULIZ; with three alidades on the bridge and one in AUX CONN, the JOOD had just as much responsibility to check on the URDULIZ as the JOOW.

During all turns the JOOD is responsible for "clearing his bridge wing"[13] and determining bearing drift of any approaching ships. The JOOD's principal function is to conn the ship in a **safe and efficient** manner. The role of safety is not just one watch officer's responsibility, but the entire teams. By relying only on the JOOW for constant feedback on the bearing drift of the URDULIZ, the JOOD exhibited poor judgment and lack of initiative. Even though he was a proven conning officer with the trust of the CO, he failed to act accordingly in the moments prior to the collision.

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[13] The practice of checking the side a turn is about to be made in to see that there are no ships in the vicinity.

D. The Port Operations Department

One of the most questionable opinions that resulted from the NTSB investigation was not to find fault for the collision with the Norfolk Port Operations Department. Throughout the investigation the reader was led to believe that Port Operations had control of all shipping within the Hampton Roads waterways. After the NTSB's findings were passed down, no recommendation was forwarded placing any fault with Port Operations. So the question becomes, why did Port Operations schedule the departure of the submarine with the arrival of the *EISENHOWER*? The schedule at NOB and Port Operations was flexible enough, according to the NTSB investigation, to accommodate such modifications. Also, why were the planners for the arrival of the *EISENHOWER* not able to expand their flexibility 29 August 1988?

By allowing the submarine *LIPSCOMB* to enter Entrance Reach Channel at the same time as the *EISENHOWER*, the Port Operations Department neglected their own requirements of having all naval vessels coordinate their arrival and departure times to "avoid conflict with other naval vessel movements in the harbor." Although this is their statement of how traffic in the area waterways is to be controlled, Port Operations made no effort to ensure the minimization of traffic in the harbor for the *EISENHOWER*'s return.

The most beneficial duty the Port Operations Department provides is waterway management in the Hampton Roads area.

The task of overseeing the safe and efficient transportation of those channels is the number one priority of the department; the scheduling of naval vessel movements is a integral part of that process. The Port Operations Department's schedule of events for the morning of 29 August 1988 was a poorly managed, disorganized attempt at carrying out its duties. Blame or fault should have been imposed on Port Operations for their handling of the traffic in the waterway that morning, and their inflexibility in accommodating change. Neither investigation produced any finding of fault.

E. The Coast Guard's Role

In both investigations the Coast Guard's role in the collision was downplayed, yet underscoring most of the investigations' findings was the fact that the channel was ill-marked and that it posed problems for conning crews entering the Norfolk Harbor. The northern edge of Entrance Reach Channel was not clearly marked with buoys. Prior to the changes, the northern boundary had been clearly marked with a buoy system that allowed a natural range for conning crews to determine their position in the Channel. The reason for not providing this buoy range subsequent to the upgrades on Entrance Reach Channel was the "...hazard to navigation" that it would pose. Vessels, as determined by the Coast Guard,

would only run over these buoys, increasing the amount of manpower and cost of constantly replacing them.

The Coast Guard's decision, therefore, sacrificed safety for economics. Coast Guard authorities were "requested" in the recommendations of the NTSB investigation to "[E]stablish additional buoys on the northern side of the Entrance Reach Channel to delineate the Channel limits."[Ref. 2:p. 40] This was the extent of the reprimand the Coast Guard received for their ill-conceived channel limits marking plan on one of the busiest waterways on the East Coast. By allowing the channel boundaries to be interpreted by ship conning crews, the Coast Guard's main function, to provide and maintain safe, efficient, and clearly marked waterways, was severely degraded. The Coast Guard's role in the collision of the *EISENHOWER* and the URDULIZ is undeniable; their approach in the channel's buoy system permitted the ambiguity in entering Norfolk Harbor.

One other item of interest in the investigation conducted by the NTSB shows the Coast Guard's inefficient handling of their own regulations. The RNA, established by the Coast Guard to thwart smaller pleasure vessels from closing on a naval vessel attempting to go pier-side, did not prove effective. The regulation requires that: "...no vessel may come within 500 yards from a aircraft carrier...restricted in its ability to maneuver...transiting the Elizabeth River between NOB and Norfolk Naval Shipyard." If the naval vessel

"requests" assistance from the Coast Guard, then the Coast Guard will provide two patrol boats stationed on the bow and the stern of the incoming carrier. Why should a carrier have to request assistance? The RNA, established by the Code of Federal Regulations (CFR) Title 33 Paragraph 165.501(d)(11), was requested by the Navy in 1982 to, "...prevent accidents due to the reduced maneuverability of vessels caused by slow speeds at which the vessels have to operate..." in the vicinity of NOB. What is even more interesting is that the Navy had the foresight to plan for the increasing amounts of traffic in 1982 when the Norfolk Harbor Reach Channel was still 1,500 feet wide. The width at the time of the accident was 1,000 feet and the Coast Guard provided no patrol boat assistance for the *EISENHOWER* on the morning of the collision. Again, the Coast Guard's part in the collision cannot be summarily dismissed; their role in the channel boundaries and the lack of patrol boat assistance are factors in the collision.

F. Summary

Five least explained and explored areas of the NTSB and Navy JAG Investigations have been identified by this author as contributory to the collision, giving the reader a stronger base of understanding why the collision occurred. The five areas discussed included: bridge watch organization, non-essential personnel on the bridge, and the roles played by the

JOOD, Port Operations, and the Coast Guard. The general lack of attention given to these factors is puzzling to this author. The reasons for this are purely speculative.

The Navy's oversights may have been due to time constraints. The *EISENHOWER* was placed in a routine 30 day standdown following her deployment. After the standdown, the ship was scheduled for a six month overhaul in the navy shipyard; in order to get to the shipyard the ship had to get underway. Knowing that the CO was going to be relieved and not wanting the ship to get underway without a CO (not a possibility), the Navy pushed to have the investigation completed prior to the scheduled yard period.

The NTSB's oversights may have been due to the limited background of the investigators in management issues, three of the key factors noted by this author. The NTSB investigation noted in their findings that the *EISENHOWER* bridge organization was in need of a more structured bridge environment to develop proper communication channels. This finding was limited to one line in the investigation. Consequently, this author speculates that the NTSB investigators were not trained to detect management/organizational problems.

G. Perrow's Interpretation

How does the *EISENHOWER* collision compare to published accounts of accidents at sea? In his book, **Normal Accidents**, Charles Perrow describes the basis for many accidents due to modern technology. His thesis reveals that many accidents occur because of the restrictive nature (tight coupling) and the interactive complexity of technological systems. A matrix explains Perrow's typology of accidents.

TABLE IV - 1
Perrow's Matrix of Accidents:
An Interaction/Coupling Chart

INTERACTIONS

	Linear	**Complex**
Tight Coupling	*Dams *Power grids *Marine transport *Rail transport *Airways 1	Nuclear power* *DNA *Aircraft *Chemical plants *Space missions 2
Loose	3 *Trade schools *Junior college *Most manufacturing	4 *Military adventures *Mining *R&D firms *Universities

COUPLING

Source: Normal Accidents

Perrow describes the matrix as a combination of the two elements necessary for a system accident. The variables, **coupling** and **interaction**, are largely independent and anchor two sides of the matrix that produces four quadrants. In each quadrant, Perrow places certain systems based on their degree of interaction and coupling.

Each quadrant subjectively measures the amount of interaction and coupling that should take place in a system of this sort. Examples of systems high in coupling, or tight coupling, are dams, power grids, and nuclear power plants. Tightly coupled systems, in quadrants 1 and 2, have the following tendencies:

- delays in processing not possible;
- invariant sequences;
- only one method to achieve goal;
- little slack possible in supplies, equipment, personnel;
- buffers and redundancies are designed-in, deliberate;
- and, substitutions of supplies, equipment, personnel are limited and designed-in.[Ref. 3:p. 95]

Loose coupling, on the other hand, has systems such as most manufacturing, universities, R&D firms, and mining. Loosely coupled systems, in quadrants 3 and 4, have the following tendencies:

- processing delays possible;
- order of sequences can be changed;
- alternative methods available;

- slack in resources possible;
- buffers and redundancies fortuitously available;
- and, substitutions fortuitously available. [Ref. 3:p. 96]

Perrow also describes the placement of linear and complex systems on the interaction axis. The linear systems, according to Perrow, have these tendencies:

- equipment spread out;
- segregated production steps;
- common-mode connections limited to power supply and environment.
- easy isolation of failed components;
- less personnel specialization;
- extensive substitution of supplies and materials;
- few unfamiliar or unintended feedback loops;
- control parameters few, direct, and segregated;
- direct, on-line information sources;
- and, extensive understanding of all processes. [Ref. 3:p. 88]

Linear-based systems tend to be located in quadrants 1 and 3. Systems of this variety include: assembly-line production, rail transport, and **marine transport**. Perrow identifies marine transport as being towards the center of linear and complex interaction, but relatively high (tight) on coupling.

The properties of complex systems can be summarized as:

- tight spacing of equipment;
- proximate production steps;

- many common-mode connections of components not in production sequence;
- limited isolation of failed components;
- personnel specialization limits awareness of interdependencies;
- unfamiliar or unintended feedback loops;
- many control parameters with potential interactions;
- indirect or inferential information sources;
- and, limited understanding of some processes. [Ref. 3:p. 88]

Complex systems include DNA research, military adventures, nuclear weapons accidents.

The key to linear and complex systems is "...the awareness of interdependencies..." between the parts, units, or subsystems in a system. In complex systems, Perrow explains, unanticipated interdependencies are more likely because of the higher rate of failure of a part or unit. Among his theories: marine transport, high in coupling and low in interaction, is an error-inducing system, whereby ships will spend thousands of dollars for the newest navigation equipment enabling them to take even greater risks. He feels that in a highly (tightly) coupled system, failures appear to be continuous. However, with the slowness of shipping, recovery from potential accidents, he hypothesizes, should almost always be possible.

Although Perrow's thesis is beneficial for the typology he submits, the *EISENHOWER* collision does not, in this author's

view, fit into any of the quadrants proposed by Perrow's interaction/coupling matrix of a "normal accident". Perrow's definition of a "normal accident" is centered on the technological aspects of system failures. The *EISENHOWER* collision was not a technology-induced accident. Rather, it was a mishap caused by the organizational flaws present in the bridge watch team. His thesis does reinforce the argument that the error-inducing character of a ship lies in the social organization of a ship. [Ref. 3:p. 10] This is the underpinning of the *EISENHOWER* collision.

The NTSB investigation revealed that bridge management and team coordination principles were not adequately emphasized in the training of shipboard COs and bridge navigation personnel on Navy vessels [Ref. 2:p. 38]. This finding is strikingly similar to what Perrow specifies. The organization is the centerpiece of many accident inquiries. Operators (OODs) must have the latitude to be able to take action. An evolution such as sea and anchor detail or entering port must be a tightly coupled procedure where the risk of error is controlled by following a precise and explicit check-off list. The opportunity for a proactive style of management by the OOD or his watch team is always present, but in certain evolutions, entering port and sea and anchor detail, the likelihood is lessened.

As for classifying the *EISENHOWER* collision a "normal accident", Perrow's typology does not, in the author's mind,

conform to the events related to the collision. The important contribution from the Perrow book is his recognition that for a ship to be operated efficiently it must have a stable, well-coordinated social organization. At the time of the collision, the ***EISENHOWER***'s bridge organization was in utter disarray.

V. SUMMARY AND CONCLUSIONS

A. A Final Viewpoint

The following question inspired the analysis of the *EISENHOWER* collision.

(1) What were the contributory factors that led to the collision? And in particular, why did established entering port procedures systematically breakdown in the moments prior to the collision?

(2) To what extent was the U.S. Navy JAG Investigation supported by the NTSB Investigation?

(3) Was the collision a "normal accident" as defined by Charles Perrow?

(4) And finally, did the collision change COMMANDER, NAVAL AIR FORCES, ATLANTIC (CNAL) and COMMANDER, NAVAL AIR FORCES, PACIFIC (CNAP) procedures for aircraft carriers entering port after extended deployments?

The research process was limited to unclassified materials and sources. The primary sources for the analysis were the NTSB investigation, the U.S. Navy JAG investigation, and personal interview data obtained from the OOD, JOOD, JOOW, and Helm Safety Officer.

The *EISENHOWER* collided with the URDULIZ due to the lack of timely, prudent action by the CO, Navigator, OOD, and JOOD.

By examining the investigations and having firsthand knowledge of the ***EISENHOWER***'s bridge watch team organization, the author also identified numerous other causal factors that were not thoroughly considered by the NTSB or JAG. The author also determined other contributory factors in the collision (as described in the text) that were not fully explored in either investigation. Some of these include the following:

- The JOOD's position on the watch team is one that continuously assists the OOD in his duties. Conning the ship is only one of the many responsibilities of the JOOD. Neither investigation pointed out the fact that the JOOD never determined the bearing drift of the URDULIZ prior to, during, or after the turn to 229° (the opening to the Entrance Reach Channel). The view that he was an unqualified JOOD and an Ensign and should not be held accountable for his lack of proper action is without merit. The investigation's presumption that he was a "parrot" for the OOD's orders is accurate in most instances; however, it does not excuse or relieve him from his responsibility of standing a proper, vigilant watch.
- Norfolk Port Operations' role in the collision is also a contributory factor in the collision. The regulations of the department were not even observed the morning of the collision, yet neither investigation considered this

unusual. The Department's requirement to keep two deep draft vessels from meeting in the channel was overlooked by the investigators, and was not even judged to be a causal factor.

- Finally, the Coast Guard's inability to foresee the necessity for channel boundary markers (buoys) to delineate the northern edge of Entrance Reach Channel was not perceived to be a factor in the collision. By not properly marking the channel edge, the Coast Guard was remiss in its most primary function: to provide safe and efficient waterways for waterborne transportation.

With regard to the first research question concerning the breakdown of required procedures, the author determined:

- Over reliance on the Navigator by certain OODs prevented the OODs from initiating action and thinking through problems on their own. Instead they believed that "whatever the 'Gator said was right." This reliance on one individual, whose skills were suspect, contributed to poor problem solving and decisionmaking by the watch team. The Navigator's charisma and ability to downplay potential danger compounded this problem. It also led to the breakdown in communication between the CO, Navigator, and OOD.
- Both investigations probed the question of too many non-essential personnel on the bridge at the time of the collision. Neither considered it a contributory factor in

the collision. Of the officers interviewed by the author, all felt that the noise on the bridge that morning was too loud. As explained in the text, the normal number of personnel on the bridge during a sea and anchor detail was approximately 20. On the morning of the collision the number was closer to 40-42. The extraneous stimuli on the bridge created confusion and induced those on the bridge to filter out relevant information.

How complementary were the two investigations by the Navy JAG and the NTSB? Given the fact that the Navy's investigation was originated, developed, and finalized prior to the NTSB's, it is likely that the NTSB investigation used some of the relevant facts in its own inquiry.

The chief consideration in the JAG investigation was to establish blame and take prompt punitive action against those officers and enlisted personnel involved, and to assist attorneys in litigation matters. However, in its 30 day limit to determine the causes, the Navy overlooked several additional factors that unequivocally contributed to the collision on 29 August 1988 (i.e., role of Port Operations, Coast Guard, meteorological conditions, etc.,)

The NTSB's primary responsibility was to determine the overall cause/causes of the collision and report those findings. The NTSB is an agency mandated by the federal government to investigate and determine the causes of accidents, issue safety recommendations, study safety issues,

and evaluate the safety of all government agencies involved in transportation. Therefore, the nature of the two investigations and their goals differed. On the whole, the NTSB did support the JAG's and did rely on facts from the Navy's investigation, but it did not use the JAG's framework to determine responsibility. Finally, the author was unable to completely resolve the fourth research question pertaining to the current entering port procedures of CNAL and CNAP. After the collision, a Special Sea and Anchor Detail team was instituted on the *EISENHOWER*. Whether this procedure was adopted by all carriers under the cognizant commands of CNAL and CNAP is unknown. The *EISENHOWER* Special Sea and Anchor team was the only team authorized by the new CO to pilot the ship in and out of port. Also, only watch personnel were allowed on the bridge during special evolutions. The QMOW would actually tape shut the doorway to the bridge to keep away curious onlookers.

As for pilots, the Navy quickly established a requirement that all naval vessels away from her homeport over three months would employ a pilot. The regulation was not fully enforced, however, and the practice was again left to the CO's discretion. This return to past procedure occurred in 1989, one year after the collision, when the novelty of it had worn off. When the author departed the *EISENHOWER*, the process of entering port was a common procedure because of the ship's active schedule. Old habits returned; the reappearance of

non-essential personnel on the bridge during special evolutions again was a problem. The use of pilots did occur on the *EISENHOWER*, but the procedure was not strictly enforced. Overall, the months following the collision were filled with extreme caution on the waterways around Hampton Roads. After a year, the routine of not employing a pilot was reestablished.

B. Recommendations

The *EISENHOWER* collision was undeniably avoidable. Had the ship been equipped with a training device (a simulator that perhaps could be operated through the Naval Tactical Data System - NTDS) that could reproduce any type of natural weather phenomena (tidal current, wind, visibility, etc.,) the probability of the collision may have been decreased. A simulator of this type is located at the Naval Education and Training Center (NETC) Newport, Rhode Island. The simulator is used to train incoming SWOs on proper shiphandling skills and orders. The size of the simulator could be reduced to fit on surface ships; this could expand the amount of training junior and senior officers involved in bridge operations receive, and at the same time provide abnormal scenarios that teach the "student" to react. Programming in alternative scenarios, the simulator would provide limitless opportunities for those bridge officers to hone their skills.

The risk involved in operating the largest naval vessel can never be completely eliminated just as the risk of driving a car can never be eliminated. What can be controlled, to some extent, is the training environment. The inclusion of a simulator-type training aid for afloat commands would greatly enhance the professionalism and skills of shiphandlers, navigators, and commanding officers.

C. Future Research

It is hoped that future research of this type will continue. All parties can benefit from improvements in the investigative process. What is learned by one may benefit the whole in the long term. The benefits of further analysis may also expand the understanding of how such incidents can occur, and perhaps eliminate the possibility of others happening in the future.

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